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to
GENIUS

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FROM CRETIN TO GENIUS

FROM
CRETIN to GENIUS

by
Dr. Serge Voronoff



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TO MY WIFE GERTY

*“Is not love the most marvelous
stimulant to thought and inspiration?”*

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CHAPTER I

THE SOUL AND THE MIND

My study of mind and emotion in the animal kingdom, *Love and Thought In Animals and Men*, was published in London in 1937. The authentic instances cited therein prove that animals can make decisions which are determined by voluntary thought processes, in situations for which their instincts do not provide.

Intelligence varies in degree among all species of animals, just as it does among men; some individuals are intelligent, and some are stupid. Certain horses are very wily, and many dogs, foxes, bears, etc., show traits of intelligence. Indian elephants are known to take independent action after careful deliberation, and to act exactly as men would under similar circumstances.

While observing my monkeys, I have not only seen acts which demand concentrated thought, but I have also noticed, among the more intelligent, a tendency toward inventiveness, and an ability to adapt for greater utility the objects placed at their disposal. My researches have afforded me exceptional opportunities to observe animals, especially monkeys (more than a thousand in the last twenty-five years), and I have appraised their intelligent acts carefully on innumerable occasions.

The cerebral cells of the *higher animals* show under the microscope the same general construction as ours, but they are less evolved. The brains of chimpanzees, orangutangs and gorillas, of which I have some specimens preserved in my laboratory, do not differ from ours in structure, but only because they have fewer folds and circumvolutions. Therefore, since there is no fundamental difference between the brains of the higher animals and our own, it follows that *the relationship between their cerebral matter and their minds must be of the same nature as the relationship between ours*. In this present volume, a study of the manifestations of genius in the human mind, I give examples of men absolutely deprived of intelligence, cretins with atrophied brains, yet gifted with some kind of genius, thanks to the survival of some cerebral cells endowed by chance with extraordinary qualities.

Such extreme cases help us to a clearer understanding of the relation between mind and cerebral matter, and prove that as long as the smallest fragment of brain exists, it will produce thought.

In my chapter on the subconscious, I emphasize the connection between mind and matter by even specifying the part of the brain which harbors the thoughts created by genius in flashes of inspiration, without the genius himself being aware of them, and the part of the same brain which is responsible for the conscious thoughts common to all men.

In several chapters I study the role played by the sub-conscious part of the brain in the works of poets, men of letters, composers, scientists and philosophers. I even go so far as to seek that marvelous portion of the brain of genius in the germ, the initial cell whence man comes, and this enables me to find the solution of the enigma presented by the advent of genius in a very mediocre family, which nothing seemed to have destined to produce anything out of the ordinary.

While analysing the relationship between cerebral matter and mind in various circumstances and while trying to fathom the mental processes of men of genius, I was faced with the problem of the inner mechanism of our thoughts.

The sciences of brain anatomy and physiology teach us the structure and reactions of that organ, but leave us with this perplexing mystery: does the brain produce mind independently, or is it an instrument used by the soul for its production?

Does the brain itself think, or is it made to think?

Does the cerebral cell manufacture mind, as the liver cell manufactures bile, or is it the sole exception in our body, because of the peculiar character of its invisible product, and does it remain dependent upon the soul which governs its action? Is mind the product of cerebral matter, or is it the emanation of the soul through that matter?

Can matter think?

Does the soul always intervene?

Does the soul regulate our higher thoughts, as well as the ordinary ones which come and go, determined as they are by the activity of our daily lives, and by the cares of our petty earthly interests? Is it possible to attribute our ordinary thoughts to cerebral matter, and our noble and lofty ones to the soul's intervention? I am afraid such a division is absolutely impossible.

We are faced with a dilemma. Either matter can produce mind, or it cannot. If we go so far as to admit that the brain does not need the soul for certain thoughts, and that matter can produce them, we rule out all relation between the soul and the brain. If the brain is only the soul's instrument, then it can never function independently, and if it does, on some occasions, then it is not an instrument, but an active agent, a generator of thought.

The solution to this problem will never be found as long as we are in the dark about the real nature of mind. If mind is an immaterial essence, cerebral matter cannot produce it without the intervention of the immaterial soul, for matter cannot produce the immaterial. On the other hand, if mind is a material entity, a sublime form of matter, the soul can have nothing whatever to do with it.

Before I come to my main subject, I shall propose in my second chapter some ideas which should help to solve this tantalizing enigma.

CHAPTER II

MIND AND MATTER

Let us first ascertain the principle which animates the body.

The first cry, the first breath of a child at birth, does not signify the beginning of its life. In reality, human life begins as soon as male and female germinal cells fuse in the act of fecundation. At that moment father and mother transmit the "life" within them, that "life" which has come down to them from their remotest ancestors. By "life", I mean the initial spirit or breath which first animated inert matter; it appeared billions of years ago and it has perpetuated itself on earth, by transmission from one living being to his successor.

"Life" is the great mystery of the universe, a mystery which does not reside in the tardy emergence of man, but goes back to the first cell that was ever in motion upon earth. It is the same everywhere, but the cells it animates differ according to the kingdom to which they belong.

Differentiation between plants and animals is, today, still difficult to establish on the lowest scale. It came about slowly, as a result of the gradually increasing perfection of living matter within the animal kingdom; it was marked by the formation of the nervous system, by the latter's

progressive refinement, as more and more complex organisms appeared, and, later, by the appearance of a special organ, the brain, upon which the psychical functions devolved. Fast as the brain developed and grew, thought and feelings became manifest in the animal world and reached their wondrous flowering in man. Deprive an animal of its brain, and all manifestations of intelligence cease forthwith. In man the atrophying of the brain is always accompanied by idiocy.

Intelligence is also influenced by any change in the chemical composition of the brain cells; it can even be completely absent where there is a lack of certain substances indispensable to the physico-chemical reactions which condition the psychical functioning of these cells. Thus, children possessing a normal brain, but born with an atrophied thyroid gland, remain idiots—a fact which permits us to delve more deeply into the mechanism of thought and its formation. In the absence of the chemical substances which the thyroid gland normally transmits to the brain, the latter's mental functioning ceases. By the same token, to restore mental activity immediately, one need but supply the brain with this chemical substance—thyroxine—by the grafting of a monkey's thyroid. Indeed, I myself have often done this.

At once, thought, will, feeling and consciousness appear, as it were, miraculously, thanks to thyroxine, a substance which can actually be produced synthetically. The

brain cells renew their functioning, the idiot child becomes intelligent.

Conversely, while the backward child can regain its mental faculties, thanks to thyroxine drawn from a monkey's gland or from a laboratory of organic chemistry, the most intelligent man would become an idiot through removal of his thyroid glands. The brain cells, deprived of thyroidal hormones, i. e., of thyroxine, could no longer form certain chemical combinations through which thought and feelings are expressed.

Any modification of the normal constitution of the brain cell—through the addition of noxious substances carried in the blood stream in certain diseases, or as a result of the absorption of certain substances—influences the intellectual faculties; it excites or confuses or annihilates them. Furthermore, we know that all thought or feeling is accompanied by an electrical current; we possess abundant experimental proof of it.

At the Salpêtrière Hospital in Paris, as in other neurological institutions abroad, there are apparati which register the activity of the brain by the more or less marked emission of electrical current. Two electrodes are placed on the head of a person with wires connected to amplifiers. Infinitesimal electrical pulsations that proceed from the head of the person experimented upon are recorded upon a film, and with the aid of the amplifiers the psychical activity of the brain is thus charted. Any

thought, mild or violent, any feeling, happy or unhappy, is recorded by a different graph. The electric oscillations in the brain follow particular rhythms. Scanning the chart, we can tell whether the thought was joyous or sad, whether the feeling experienced was happy or painful. For the electric waves change according to the character of each thought and each feeling.

The physico-chemical reactions in the brain cell and the intra-cellular electric current are the elements of the activity of the brain, the source of all our feelings, the mainspring of all the manifestations of our intelligence.

To be sure, some persons are reluctant to admit that the brain can generate thought without the interposition of some mysterious, immaterial element; nevertheless, they recognize that this mysterious element needs brain matter in order to elaborate and to manifest thought. To deny it were ridiculous; without the brain, no thought were possible. But the brain is nothing other than a mass of protoplasmic matter, highly brittle and complex in its composition, yet perfectly familiar to us. What, then, can such a protoplasmic mass elaborate? What can some immaterial element extract from such matter?

Obviously, all transformation, all manifestations of matter can be only matter. If, therefore, cerebral matter manifests its activity by the production of mind, we are bound to admit that mind is a material substance, very particular in kind no doubt, but undeniably material. Matter cannot produce anything immaterial.

Nevertheless, a mysterious element does exist; its name is "life". This "life" does not produce the mind, any more than it causes our glands to secrete, or our muscles to contract. Its sole function is to animate the cells which perform according to their constitution and their adaptation to a determined function. Without "life", every cell is but a fragment of inert matter; let "life" animate it, and it becomes a being in action.

Still, we cannot liken mind to a secretion of the brain, to a product akin to the physico-chemical substances which the other cells of our body elaborate, and which may be analyzed chemically. So we must ascertain the manner in which cerebral matter can manifest itself in order to produce something invisible yet material, something capable of expression by what we call mind or feeling. This attribute of matter exists. It is called "*radiation*".

Every bit of matter gives off a radiation which is translated into the emission of infinitesimal and invisible grains; but in most cases, this radiation is too slight to be noted. Sunlight offers a typical example of this radiation; so, too, does the light which comes to us from all stars, from X-rays and from radium. These divers lights are composed of microscopic grains derived from the source which emitted them. What appears to us to be manifested under a continuous and uninterrupted aspect is in reality a succession of infinitesimal corpuscles of the radiating matter, sun, stars, radium, etc. And electricity, that invisible, impalpable fluid, likewise consists of a sequence

of grains, ultra-microscopically small; they are still matter, but divided into such infinitesimal parcels as to give the impression of continuity.

So it is with cerebral matter, which emits radiations that *propel the invisible grains of thinking matter*. Loss of this matter by radiation is so minute that it may be dismissed as nil, just as with a unit of radium, one millimetre of which may be consumed in the course of one thousand years, without the unit ceasing to radiate.

In attributing the functioning of the mind to cerebral matter, I repeat, I do not mean to deny the existence of a mysterious element which allows matter to think. But this "element" is none other than "life", the animator of every cell in the body. What this "life" is, we do not know; nor whence comes this initial afflatus which appeared upon earth. Whether a gift from the Divinity who, by this vital impulsion, animated matter, or whether a result of physico-chemical forces and conditions possibly existing in the earliest eras of earth's formation, the fact remains that, thanks to this mysterious element, matter was first set in motion.

Because of this mysterious quickening force, everywhere similar, the plant decks itself with flowers, the liver cells secrete bile, the brain cells generate thoughts and feelings. "Life" no sooner quickens matter than it endows it with all possibilities of development and of perfectibility, with all dispositions and aptitudes, and enables matter to manifest itself in accordance with its constitu-

tion, its evolution, its adaptation to a special function. Thanks to the presence, in our brain cells, of this mysterious animator of all things existing upon our planet, the invisible particles of cerebral matter, piloted by electric waves, manifest our thoughts and our feelings.

Psychical radiations emanate from all brains. By their material essence, they form an entity that proves capable of impressing itself upon other brains. The speed with which thought is propagated may be identified with the speed of the electricity with which psychical radiations are charged.

What becomes of this thinking matter projected from the brain? Will the emitted thought, formed of invisible particles of cerebral matter, vanish without a trace? Can matter, however intangible, disappear forever?

Certain discoveries, made simultaneously in various countries, often give rise to violent claims of priority. It is said that an idea floats in space, ready to fertilize any receptive genius. Perhaps it really does. Who then is its true author? Was it independently conceived by all those who discovered it simultaneously, or is a single one of them its true author, and the rest but unwitting pilferers? And what part does Time play?

Two hundred and eighty years before Christ, *Aristarchus of Samos*, Greek philosopher, declared that the earth revolved about the sun. Scant attention was paid him; the ingenuous notion of a sun revolving about the earth, hub of the universe, prevailed. And so it went, until the six-

teenth century of our era, when *Copernicus* appeared to proclaim once again a thought formulated by Aristarchus eighteen centuries before. Had Copernicus conceived it independently, or had Aristarchus' idea, hovering ever present, at last met a receptive mind, set on the same problem, ready to take and develop its imprint?

The evolution of species was enunciated by the Greek philosopher, *Anaximander*, six hundred years before the Christian era. Two thousand, four hundred years later, in 1859, *Darwin* presented the same hypothesis. Was it his own idea, or was it Anaximander's he had recaptured? Had the original idea survived, awaiting a superior spirit to receive it, or did Darwin reproduce it out of whole cloth?

By pure insight, with nothing to guide or instruct him, without any factual observations, the Greek philosopher *Leucippus* (450 B. C.) expressed the unprecedented idea that matter was composed of atoms, of infinitesimal and invisible particles in perpetual motion. Here was a vision of genius, a divining of nature's deepest secret. With the help of ultra-sensitive apparatus, modern scientists have now demonstrated that the innermost composition of matter is really as Leucippus imagined it. Is the discovery theirs by right? Was Leucippus simply a forerunner, and had the modern discovery no link with his? May we not just as well suppose that the cerebral radiations emitted by the brain of Leucippus, and *materializ-*

ing his thought, played the determining part by impressing the brain of a modern scientist?

Thought transference (examples of which are innumerable, and which I myself have witnessed on two occasions, and mind reading, which I have also witnessed in action beyond a shadow of doubt) has nothing of the mysterious about it. Thought, expressed by microscopic particles emitted by the brain, is a reality, as real a thing as, say, letters suspended in mid-air by an invisible thread. Thought can be read; the brain, in certain states of receptivity, actually does read it. Thought, expressed by radiations from the brain, travels through space and may be intercepted and deciphered under certain favorable conditions.

Cerebral matter and thought are one; the physical and the mental merge, thanks to the presence, in matter, of a non-material principle, namely "life", which permits every cell of the body to accomplish its function, be it chemical, mechanical or psychical.

This same non-material principle animates both genius and cretin, but it is their cerebral matter which differs. Attaining miraculous development in the case of the genius, it is atrophied in that of the cretin. Let but a single cellular centre endowed with attributes of genius survive in an atrophied brain, and your cretin will display them.

The study of genius is the study of the highest psychical attribute which thinking matter is capable of possessing.

CHAPTER III

FROM CRETIN TO GENIUS

The man of genius is a creator.

In every field, Art, Literature and Science, he creates works whose quality and originality surpass the powers of normal intelligence, however great; nor does his own conscious intelligence possess this power. Genius is an inborn autonomous faculty, independent of general mentality, and manifested by sudden inspiration.

When the obscure workings that take place in the subconscious suddenly bring the solution of a problem to the consciousness of a man of genius, the latter gains perception of it as of something coming from the outside world. Consciousness and reason then possess themselves of it in order to examine this contribution, to draw deductions therefrom, to adapt it to the needs of an expression, a technique, a practical application.

Such inspirations often occur after several days of studied efforts to solve a problem or to find the form in which to clothe an idea or a work of art, painful efforts which may have seemed wholly fruitless. It would seem as though the subconscious witnessed this effort of the conscious ego, realized its impotence and imperfection, and suddenly, when least expected, at last brought the

vainly-sought solution. This contribution of the subconscious so far exceeds the faculties which each one of us recognizes as his in a normal state, that the man of genius himself remains dazzled by this revelation, whose origin is shrouded in mystery.

The man of genius is a visionary. From birth he is provided by heredity with a marvelous aptitude, a sublime gift, independent of his general mentality, and related to a hypertrophied centre of the brain. Sometimes the dissociation between the genius-like qualities of the subconscious and the qualities of the conscious mind is so striking that it is difficult to credit a person known to us in his daily round, as the author of his masterpiece.

Thus Oliver Goldsmith, author of the *Vicar of Wakefield*, was, according to Horace Walpole, an inspired idiot. "I do believe," said one of his companions, "that it is indeed he himself who wrote his own works, but that is no small matter to believe."

The French poet, Auguste Barbier, was, according to his younger colleague, de Hérédia, the stupidest man he had ever known, but a good poet nonetheless. The same opinion was current about the famous French painter, Gustave Courbet. Exceptional attainments bordering upon genius can in fact be associated with feebleness of mind, and even idiocy. This is to be observed particularly in musicians and mathematicians.

A gift for the arrangement of sounds and figures, when this aptitude comes at birth, by heredity, is a quality more

easily expressed than other qualities, which require a more or less lengthy training. We know that the acquisition of musical sounds is anterior to that of the spoken word; mere infants can repeat a scale before being able to talk. Mathematicians are also very precocious, because their subject-matter is very simple, though it does constitute a wondrous science.

In order to manipulate figures and mathematical problems, there is no need, as in the plastic arts or experimental sciences, of an extensive knowledge of facts and processes which can only be acquired with time. Indeed, there are records of cases where backward, even idiotic children, were endowed with an innate gift for mathematics or music, manifested at the tenderest age.

Dagonet, in his treatise on mental diseases, cites several idiots, male and female, gifted with remarkable musical talents. They were children of musicians. One corroborative example, among many others, is furnished us by a child, J.V., born at St. Donat, in the Drôme department, on April 6, 1909. From the age of six, he was the object of study by physicians and musicians. According to the last report which reached me, he was unable to talk, at the age of fifteen. He could utter hoarse cries, but was totally incapable of comprehension. He presented an instance of the characteristic type of idiot known as myxoedematous cretin. All efforts to educate him were futile; but the faculty of music was revealed in him when he was still in the cradle. Objects interested him only insofar as

he was able to extract sounds from them. From the age of six, he would play the most complicated classical and modern pieces with his mother, an accomplished musician. He would often make variations, and immediately, without preliminary trial, would key the piano to the pitch of the voice or the instruments of those who played with him, just as did Mozart, that fabulous musical genius and eminently intelligent man. Without leaving the note on which his finger was placed, he would immediately transpose, either on his own account, or in order to sustain the voice of the instrument. His musical memory was prodigious, his repertory considerable. What astonished those who watched him, physicians or musicians, was the careless ease with which he interpreted pieces, for he never paid the slightest heed to what he was playing, and never looked at the keyboard. While playing, he appeared to be most interested in the flies buzzing about him. For all his inattention, he never struck a false key, but played on and on, like an automaton. The child possessed no fingering ability; he placed almost the whole of his hands on the keyboard, his fingers winding between the black and white keys.

At fifteen, he played exactly as he did at six. He had made no progress. Recently I learned that he is still alive, that his musical memory remains prodigious and his execution perfect, but that there has been no progress. This is precisely where a cretin differs from an intelligent musician. Both have been marvelously gifted by nature, but

the former is incapable of progress for want of education, while the latter progresses constantly with the development of his intelligence, teaching, culture, effort and labor.

Several other instances might be cited, similar to this one.

It may be remarked that such musical manifestations are never observed in cases of accidental idiocy, resulting from a disease of the brain in a child formerly in possession of all its intelligence. They occur only in cases of congenital idiocy. Some congenital idiots bring their gifts with them at birth, and could be real geniuses if this inherited gift were supported by an intelligence capable of education, development and progress. Lacking such intelligence, their magnificent gift remains secluded in a compartment of the brain where it receives neither appeal nor stimulus, and where it may even be stifled. Indeed, cretins are sometimes known to lose their genius-like aptitudes with puberty, at a time when sex instinct is apt to deflect artistic interests and inclinations.

The same observation has been made in regard to the gift of calculation and mathematical problems. This birth-right of the prodigy in mental calculation is noticeable at all stages of intelligence, among those destined to be the most brilliant of mathematicians no less than among cretins. The former, endowed with fine minds, include such famous mathematicians as Friedrich Gauss, and Wathely, both of whom revealed amazing powers of calculation at

the age of three, as well as André Marie Ampère, who did so at four. The idiot Colburn displayed the same talents at six, the cretin Mondeux at ten, while Inaudi, who was retarded without being altogether an idiot, displayed these same gifts at six.

The case of Henri Mondeux (1826–1862) is the most typical. He was a simple shepherd in Touraine. Unable to read or write, he would amuse himself in his solitude by making the most vertiginous mental calculations. By chance his gift came to light. Jacoby, elementary school-teacher of Tours, brought him into his home in order to educate him. Jacoby, believing that he had a genius to deal with, attempted to instruct his ward. But in vain: the child was mentally retarded. In 1840 he brought him to Paris, and presented him to the Academy of Sciences. A committee of inquiry, which included the greatest mathematicians of the time, Dominique François Arago and Baron Augustin Cauchy, reported in its findings the astounding aptitude of this ignorant simpleton-calculator.

Innate gifts of this sort stem from the same origin as those of true geniuses who have won fame through their works. To be sure, cases I have mentioned are exceptional; they merely prove that true geniuses are generally equipped with fine minds. Otherwise, their marvelous natural gifts could not possibly develop along the lines that dazzle us throughout their lifetime.

But the extraordinary musical, mathematical and even at times poetic gifts of certain cretins throw some light on

the sublime quality which goes into the making of a genius. Anatomically, genius is always united to a particular structure, to a particular organization of the brain. The various portions of this organ, of course, are not equal in value. The general intelligence is concentrated in the frontal part of the brain. In the case of artists, an extremely well developed centre, or grouping of cells, appears in the foremost section of that frontal part. This peculiarity has been recorded in the case of certain great artists whose brains have been examined in our times. *Beethoven* and *Bach* furnish the most striking examples of enormous development in this one brain centre.

On the other hand, a study of the brains of eighteen famous scientists displayed a pronounced development of the parietal (side) and occipital (back) portions. These contain an abundance of circumvolutions, of folds and protuberances which considerably increase the mass of that part of the brain.

The centre of speech is situated in the left parietal portion. It is known as the Broca centre, in honor of the scientist who discovered it. The autopsy performed on *Leon Gambetta*, renowned for his oratory, revealed that the Broca centre occupied twice the space found in the average man. On the other hand, in Alphonse Bertillon—a great scientist but a pitiable speaker—this centre of speech was below normal.

In the case of artists, poets and scientists, the existence of specialized brain centres, their perfecting, develop-

ment and autonomy, clearly reveal to us the role of the subconscious. Here, these specialized anatomical centres suffice for the production of genius-like work, without calling upon the conscious intelligence for assistance.

The wonderful qualities which genius displays are not necessarily associated with a superior intelligence; they express, rather, the functioning of the specialized centres genius inherited. Thus the quality of genius is located in certain regions of the brain which develop out of all proportion. Other regions remain normal, unless they are sacrificed somewhat in favor of those portions which contain genius and occupy a disproportionately large place in the organ of thought.

In any case, we should not admire a man of genius the less, simply because we observe that, exclusive of his genius, he may be equipped with average, and in a few rare cases, with less than average intelligence. This sometimes happens to musicians and mathematicians, who can afford the luxury of possessing pure genius and nothing more. For other types of genius, a sound intelligence is required in order to ensure collaboration between the conscious and the subconscious. A genius, moreover, always suffers a handicap when it comes to commanding respect for even an excellent intelligence, outside the specific field of his genius. The admiration aroused by the latter, by the sublimity of his inspired work in art, literature or science, naturally overshadows his intelligence, however high.

Is not genius the highest degree which a human faculty can attain? There is, in the inspired thoughts of the man of genius, something beyond measure, something extraordinary which reveals itself in his work. Outside his hours of inspiration, he may be only a more or less intelligent or cultured man; indeed, a remark once made about *Leon Baptiste Lully*, the great Italian musician, is wholly applicable to some geniuses. Entering the service of Mademoiselle de Montpensier as flunkey, then as scullion, Lully revealed his musical talents, composed twenty operas and wrote the score for all of Molière's comedies and ballets. Defending him against reproaches levelled at his ineptitudes, his friends would shrug their shoulders. "You must not expect common sense from him," they would say. "He is all genius."

The genius is isolated. The call of the subconscious, the ferment of ideas which hold his attention, make him habitually absent-minded, uncommunicative. He lives in his sublime thoughts, which place him outside contemporaneous humanity, for genius is a vision, a discernment of the future. Moments of inspiration bring an idea, a discovery, an invention, an outline of a work of art; but apart from this sudden illumination, the brain continuously dwells upon it, the conscious scrutinizes the suggestion of the subconscious, criticizing it and adapting it to the needs of the technique. So the genius remains constantly preoccupied by this interior labor, passes from the subconscious to the conscious, scarcely has time or inclina-

tion to attend to what does not concern the production of his mind. The genius is a superman, he transcends his times and his surroundings. In his sphere, as he builds the future, he remains alien to the existing mentality. He is often considered a visionary, an abnormality; often he is understood only very much later, when hostile, jealous and odious contemporaries have disappeared and evolving humanity has adapted itself to new ideas.

There is much truth in the sally of *Swift*, the English satirist: "When a genius appears, you can recognize him by the fact that fools will all band together against him." Among so many great men who were hated and persecuted, how perfectly the case of Pasteur confirms Swift's dictum! But fools are everywhere! Those who denied Pasteur's prodigious, miraculous discoveries sat in the French Academy of Medicine.

Happier are those endowed merely with talent, a quality more readily accessible to their contemporaries. At that, it is sometimes difficult to distinguish between the man of genius and a talented man. Both are born with a gift, both are endowed with a very particular capability, both are creators; the difference between them is a matter of degree. It is not always easy to tell where talent ends and genius begins. The inspiration of talent generally reproduces the accepted fact, that of genius, the new. The former deduces or repeats, the latter invents or creates. Talent aims at a goal which appears to us difficult of attainment, genius at a goal which is wholly invisible. The

share of inventiveness and of creativeness which men of great talent possess is precisely what makes them most closely resemble geniuses, but they can never equal them.

Let us imagine a painter possessed of great ability. If he is satisfied with painting as others have painted before him, without innovating or contributing a fresh method either in coloring or in choice of subject, either in the composition or in the lighting of his canvas, his talent may be vaunted but he can never qualify as a genius. He must strike the sparks of a new beauty, for without such new birth and originality, there is no genius, and he must be profoundly distinguishable from his fellows. A painter of genius is a powerful visionary, an original creator of forms, who captures at one sweep, and fascinates. The rhythm of life as it animates the faces and figures he paints, the beauty of color and the effects of light he achieves, are his characters. Since *Raphael*, twenty-five or thirty painters of genius have appeared; but there have been at least one million painters throughout the world, some of whom possessed talent. What prevented them from equalling or approaching Leonardo da Vinci, Michelangelo or Rembrandt was a grandeur and originality to which they could not pretend.

Among poets, we find simple craftsmen in art who limit themselves to clothing their thoughts after a pattern cut to the rules of prosody. Others arise whose poetic language acquires a lofty intellectual value through precision of thought and elegance of form. They have talent, true;

but where is the dazzling genius of a Dante, a Virgil, a Victor Hugo? Thought, alas! cannot be limited to the alchemy of language, the power of words. Poets of genius are creators in the realm of feeling, in the expression of the heart's responses. They succeed in incarnating in their works the eternal aspects of human passions, in irradiating the treasures of the mind, of immanent spiritual values, of the inner life. They are visionaries; a symbol, a single word opens up whole worlds to them.

Like literary production, scientific production offers greater and lesser discoveries and inventions. Discovery, for the man of genius, often consists in deducing from one isolated instance the law governing this case and all other cases too, however remote their similarity, by heightening his thoughts to astounding generalizations. Thus *Newton*, starting from the observation of an apple falling from a tree, established, with intuitive genius, the law of universal attraction, the harmony of the heavenly worlds. Thus *Darwin*, starting from the observation that a gigantic fossilized armadillo resembled the small extant armadillo, arrived at the genius-inspired concept of the evolution of species. Scientific genius is characterized by ideas which, casting light upon phenomena that had remained obscure, revolutionize the course of science.

In conclusion, while it is easy to classify cretins endowed with a genius-like faculty, it is not always possible to draw the dividing line between genius and talent, or to assign to each the proper degree of greatness.

That is the task of history.

CHAPTER IV

THE PRECOCITY OF GENIUS

Genius is inborn, not achieved. Those amazing qualities and incredible aptitudes, which seem to transcend the bounds of human capabilities, are already found fully formed in the fertilized ovum, that microscopic germ-cell whence the human being originates. It contains all that we shall ever be; indeed, we have no other source. With increasing age, we shall be but developing the qualities which this germ has brought us and which are ready to manifest themselves, as it were, from birth.

At the age of three, *Mozart* played the pianoforte. At four he was discovered by his father composing a concerto for the harpsichord. One day when Schachtner, a well-known musician of the time, was playing the second violin of a trio at Mozart's, the child, aged four, stood behind him, and insisted on playing with them. As he had not learned the first elements of the instrument, his father was reluctant to disturb the party for a child's whim; but, as the child wept at this rebuff, his father relented. "Sit down," he said. "Scratch the strings, if you must; but gently, so no one will hear you." Scarcely had the trio begun than Schachtner, who relates the anecdote, realized

that his own presence was superfluous. The child was playing his part perfectly. Schachtner accordingly let little Mozart finish the piece. Occasionally he encountered difficulties, but invariably he overcame them with the most amazing skill, thus demonstrating the incredible fact that he could play the violin without having studied it. In 1763, at the age of seven, this little prodigy played the piano as well as he did the violin, and gave concerts which filled his hearers with wonder. At ten and eleven, he produced one-act musical plays which were performed at Salzburg. A year later, he composed a three-act opera, *La Finta Semplice*, given on December 13, 1769, at the Archbishop of Salzburg's. At fourteen, within three months he composed an opera in three acts, *Mithridate di Ponto*, which was put on at the Scala in Milan, on December 29, 1779, and ran for forty performances.

Sometimes, the story goes, when taking a walk, he would suddenly stop dead, hastily draw a small notebook out of his pocket and feverishly scrawl notes upon its pages. To the friend who happened to be with him:

"Do not speak to me, do not disturb me," he would say. "There is a song in my ears. I must set it down."

Franz Liszt began to play the piano at the age of six, and to give concerts at the age of eight. On October 17, 1834, his opera *Don Sancho* appeared at the Paris Opera. He was then fourteen.

Franz Schubert wrote sonatas, symphonies and operas at the age of eleven. At thirteen, he wrote the famous song

Hajars Klaze, and at fifteen and sixteen his musical output was truly prodigious.

Ludwig von Beethoven gave his first concert at the age of eight, on May 26, 1778, at Cologne. Five years later, he had already published three sonatas which are as many masterpieces.

Charles Weber wrote six symphonies, three sonatas and an opera at the age of twelve. The opera, *Das Stumme Walkmädchen*, was in two acts; it was successfully produced in Prague, in Vienna and in St. Petersburg. He was not yet fifteen when his opera, *Peter Schmoll and His Neighbor*, made its brilliant appearance.

Felix Mendelssohn at twelve wrote a psalm played at the Conservatory. At fourteen he wrote the overture to *Midsummer Night's Dream*; by the age of fifteen, he had four operas behind him.

The most extraordinary of all, in musical precocity, was *Groteh*, the English musician, who first played the piano at the age of two, and in 1779, at three and a half, played his own compositions on the organ in London.

Turning from musicians, whose genius might be said to be revealed from the very cradle, to mathematicians, we are astounded by a precocity perhaps even greater than that of musicians. Thus *Friedrich Gauss*, a famous German astronomer of the early nineteenth century, aged three and a half, could calculate and could solve arithmetical problems; he would also trace geometrical lines and figures in the dust.

Of all of these, however, it is *Blaise Pascal*, the French mathematician, who offers outstanding testimony that genius comes at birth, equipped with a knowledge antedating consciousness, a knowledge fully formed long before the learning acquired through study. In 1635, Pascal's father, himself a good mathematician, noticed in his child, then aged twelve, a marked taste for mathematics; but he wished him first to learn Latin and Greek, so he locked up all works of a technical nature. The child, having heard geometry mentioned, insisted upon at least knowing what it was. His father answered in a general way that geometry was the means of drawing exact figures and of finding the relations and proportions of these figures and of their parts to each other. No more was needed to start the child off on discovering for himself what others had refused to disclose. During his leisure hours his mind became preoccupied with the subject; soon the walls and floor of his playroom were covered with circles, triangles, axioms and theorems. In this manner, without the slightest aid, instruction or guidance, he forged ahead for himself, and succeeded in reaching the thirty-second proposition of the first book of Euclid. Being ignorant of scientific terms, he used words of common every-day stock, calling a circle a ring, a line a bar, and so on. In point of fact, the child had discovered mathematics. At sixteen, he composed a treatise on conics, which was considered an intellectual achievement equalled only by the prowess of Archimedes. At eighteen

he invented an arithmetical machine, by means of which the most complicated calculations could be made with infallible accuracy.

Ampère, before being taught how to read or write numbers, derived his greatest pleasure from performing arithmetical operations with pebbles or beans. During a serious illness, when his mother, out of solicitude, deprived him of this means of calculation, he substituted pieces of a biscuit which the physician had permitted after a prescribed fast of several days. Calculation proved a greater necessity for him than food, even when hungry. At the age of four, knowing neither the alphabet nor numerals, he could work out impressive arithmetical calculations in his head. He became one of France's greatest physicists.

In 1726, *Alexis Claude Clairaud*, aged twelve years and eight months, read before the French Academy of Sciences, a paper he had written on four curves he had discovered. At eighteen, after the publication of his work on curves of double curvation, he was elected to the Academy of Sciences, after that body had obtained a special dispensation from the King, allowing it to break the established rule with regard to age.

José Comas Saola, the Spanish astronomer, was only ten years of age when, in 1877, he wrote his first work on astronomy. At twelve, he wrote a second, more important book, accompanied by figures he himself had drawn. A year later, using a small glass of 55mm. aperture, he made

his first observations of the sun and moon, in which he detected the presence of sun-spots.

Brunswick, at the age of three, in 1730, could reckon, solve numerical problems, and draw geometrical lines and figures in the dust.

Musical and mathematical geniuses, then, are the most precocious of all geniuses, since their subject matter requires only the evocation of sounds or numbers. We cannot hope to find any such great precocity when we survey the field of plastic arts. Here a long apprenticeship is obviously necessary. The artist must become accustomed to visualizing forms and the relationship of lines; he must acquire the ability to reproduce them; he must gain manual dexterity and technique; he must master a knowledge of matter in sculpture, or of colors and their combination in painting. Under these conditions, works of real value can scarcely be expected before a certain age. Nevertheless, the precocity of a natural gift is just as clearly marked.

Raphael drew from the age of eight onwards. In 1495, at twelve, he made drawings, the most famous of which, *The Massacre of the Innocents*, hangs in the Academy of Venice, while that charming little painting, *The Knight's Dream*, may be seen at the National Gallery in London. Between the ages of sixteen and nineteen, he had already won fame through his paintings.

At the age of four, *Claude Joseph Vernet* (1689–1714) sketched very well; at twenty he was already a renowned

painter in France. *Jean Baptiste Greuze* started at the age of eight, *Giotto*, like *Van Dyck*, at ten; *Michelangelo* at thirteen, *Dürer* at fifteen. *Titian*, *Rubens* and *Jordaens* were also very precocious. The Italian sculptor *Bernini* (1598–1680), at the age of ten, had sculptured an angel's head in marble; *Cassier*, at thirteen, was already sculpturing statues.

Among writers, an ardent imagination, the divination of characters and of the intimate life of human beings, the penetration of human passions, are inborn gifts. A work of value can scarcely be expected to emerge before the author is seventeen or more; yet the tendency towards genius, and its intimations, are apparent at a very early age.

At the age of nine, *Dante* composed a sonnet to *Beatrice*; *Tasso* wrote verses at the age of ten; *Byron* rhymed at the age of twelve, and produced his *Hours of Idleness* at the age of eighteen. At fourteen, *Victor Hugo*, dubbed the "sublime child", had already written more than three thousand lines and had begun two tragedies. His contributions to the poetry contest of the "Floral Games" of Toulouse caused such enthusiasm that his colleague, *Alexandre Soumet*, wrote him: "Your seventeen years find only admirers, unbelievers almost, here. To us you are an enigma, the secret to which only the Muses hold."

Goethe, a genius among geniuses, was also an extremely precocious child; he wrote dialogues and other pieces between the ages of six and eight. At fifteen, he

wrote *Thoughts on the Descent of Jesus Christ to Hell*.

The celebrated Russian poet, *Pushkin*, born at a time when children of the Russian nobility learned French before they learned their own tongue, wrote his first poem, *Tolgade*, and a comedy, *The Magician*, at the age of ten. *Pico Della Mirandola*, Italian savant of the fifteenth century, as a child, knew Latin, Greek, Hebrew, Arabic and Chaldean. *Ralph Waldo Emerson* was the twelve-year-old author of *Fortus*, an epic poem. The Italian poet, *Goldoni*, produced a manuscript comedy in 1801, at the age of eight, winning the amazed plaudits of all who read it. From childhood, *Ovid* spoke in poetic numbers; and *Shakespeare* must have been precocious, since he had completed his historical cycle before he was thirty-four.

Like musicians, mathematicians, painters, sculptors and writers, orators, too, offer instances of precocity. At the age of sixteen months, *Ellius Quirinus Visconti* was admired for his intelligence; at six, he was already preaching. The Archbishop of Cambrai, *Fénélon*, did so at fifteen; and at sixteen, the French bishop, *Jacques Bénigne Bossuet*, who had been preaching for four years, electrified the habitués of the Hôtel de Rambouillet, the fine flower of French intellectuality, with a midnight sermon.

Again, among scholars of genius who made great discoveries in the field of mechanical invention, it is clear that the realization of their work sometimes exacts a long apprenticeship. Invention in the mechanical, as in the

plastic arts, calls not only for education of the senses, but also for calculation and rational combination of arrangement and disposition, and for adaptation to practical necessities. During the childhood of these men, we may detect only a tendency towards genius, not a direct revelation of it.

Indeed, scientific imagination can accomplish nothing without a higher development of the faculty of abstraction, and the acquisition of a certain sum of knowledge. There are in reality two parts to those sciences which are still in course of development. On the one hand, there is the sum total of knowledge already acquired; on the other, that which is still in progress. In the former instance, all men are approximately equal, and men of genius cannot be distinguished. Truth to tell, it is often the mediocre who possess the greatest fund of acquired knowledge. But it is in the darkling reaches of science that the man of genius asserts himself unmistakably. He emerges through ideas which shed light upon phenomena hitherto obscure, and thus further the progress of learning.

Yet, although the acquisition of a certain amount of scientific knowledge is prerequisite, and naturally demands a somewhat lengthy period of time, still, the biographies of illustrious scientists, such as *Darwin*, *Spencer*, *Pasteur*, *Claude Bernard*, *Volta* and *Edison*, reveal that they were all "peculiar" children, given to silence, and,

we might say, abnormal. Genius, as yet unable to manifest itself openly in them, had already set its own particular stamp upon them.

As for the last type of geniuses we shall treat, which includes founders of various systems of religion and geniuses in the moral sphere, these are, in the very nature of things, more tardily revealed as such. We need but mention the most ancient of them, the inventor of a religion whose moral principles reach the sublime and whose charity and love extend to even the lowliest of animals. In *Buddha* we instantly recognize one of the world's mightiest geniuses. Legend has it that Buddha, at a very early age, was obsessed with the desire of finding the perfect way to salvation, not only for himself, but for all mankind as well. He first practised the most rigid asceticism, but at length, perceiving its futility, he abandoned it. For seven years he devoted himself to meditation, until finally illumination or revelation, that is to say, inspiration, descended upon him. Forthwith, he forsook the life of contemplation, and, during fifty years of unceasing pilgrimage, he preached, proselytized, organized his followers, propagated his teachings.

So, from youth on, we see Buddha obsessed with a fixed idea, until inspiration points the way and he creates a religion in which compassion encompasses all living things, man and beast, while an ever-watchful conscience leads the faithful towards universal love, the supreme ideal of the Buddhist religion.

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The conception of this religion required lengthy meditation and years of reflection; but it was inspiration which solved the problem, thanks to genius which was present at his birth, in germ, in the subconscious part of his brain.

Genius is always an innate quality. Its precocious manifestation during infancy is in itself proof enough; besides, anatomy itself furnishes the reason and, as it were, the necessity of this.

We know that all the cells of our body are continually renewed. After a short period of existence, each cell gives birth to two young cells which repeat the process. This increase in the number of cells through successive births is especially active in youth, with the growth of the body; it is still marked in the adult, and slackens in old age. Due to this continuous renewal of cells, our body no longer contains, at a given moment, any one of the cells which it possessed at birth. In every organ, the cells are replaced, their complements succeed each other at intervals varying according to age.

The brain and the nervous system are the only exceptions to this rule. *The brain cells are never renewed.* Throughout life's span we keep the same brain cells with which we were born. Their number never varies. Quite small at first, they progressively increase in size, and reach their normal dimensions at about the age of twenty, at a time when the cranial capacity has also reached its maximum.

The qualities which these brain cells possessed at birth

develop with the cells' growth, but these qualities undergo no change. The cells, when large, only accentuate the values which they possessed when small. If they contained genius, it will naturally reveal itself in childhood, as we have just seen, particularly in the case of musicians and mathematicians.

Genius possesses not only wondrous aptitude, it is simultaneously endowed with knowledge which heredity, often a distant heredity, has bequeathed to it.

CHAPTER V

THE ROLE OF THE SUBCONSCIOUS IN THE
WORK OF GENIUS

The subconscious is the psychical activity of the brain independent of the conscious ego, and acting without its knowledge. The subconscious contains the creative force from which springs all work of genius. It expresses itself by means of an inspiration revealing a power superior to the conscious individual and foreign to him, although acting through him. Many men of genius describe this condition by saying: "It is not my doing." *Musset* once wrote: "One does not work, one listens. It is as though a stranger were whispering in one's ear."

The subconscious develops, in fact, outside the field of the conscious, betraying only the synthesis, so to speak, of the work it has elaborated in silence. Once this obscure labor reveals its fruits to the consciousness of genius, the latter acquires perception of it as of something coming from the outside world. Under its influence, the man of genius produces his work at one stroke, unthinking and unreasoning, at times quite contrary to the direction and coordination required, yet always without effort.

Tolstoy declared that after a moment of emotion, a kind of exaltation seized his being, during which a swarm

of ideas, which had been ripening in his subconscious, now pervaded his consciousness. Poets, writers and even philosophers are familiar with this fact.

Schopenhauer affords one of the best examples of this method of producing a work, where the conscious plays no part and where the subconscious alone accomplishes all the labor. He actually invokes the workings of his purely subconscious mind as a proof of the soundness and accuracy of his philosophy.

"It is not I," he wrote, "who created it, it was created within me. My philosophical postulates were produced in me, without my interference, at times when my will was as though asleep, and my spirit was not directed in a given trend. My spirit received impressions from the real world and made them march parallel to its thought, all without any interference on my part. Thus my personality was virtually foreign to the work. The objective world chose my brain as an arena because it found it prepared for its advent. I merely noted, as a simple recorder, everything which at the time, and without the help of my will, came to my consciousness. Subsequently, I used these notes for my work."

Similarly, in several passages, *Carlyle* bore witness that "the subconscious is the mark of creative power, the conscious that of mere skill." The creative subconscious appears to him infinite and inexhaustible; it constitutes that mysterious region whence springs all poetry, as well as religion and social systems.

But it is *Nietzsche* who best shows us the effect of inspiration. In his *Ecce Homo*, in words of fire, this great man whose genius was so close to madness, declares:

“. . . something profoundly convulsive and disturbing suddenly becomes visible and audible with indescribable definiteness and exactness. One hears—one does not seek; one takes—one does not ask who gives. A thought flashes out like lightning, inevitably, without hesitation—I have never had any choice about it. There is an ecstasy whose terrific tension is sometimes released by a flood of tears, during which one's progress varies from involuntary impetuosity to involuntary slowness. There is the feeling that one is utterly out of hand, with the most distinct consciousness of an infinitude of shuddering thrills that pass through one from head to foot; there is a profound happiness in which the most painful and gloomy feelings are not discordant in effect, but are required as necessary colors in this overflow of light. There is an instinct for rhythmic relations which embraces an entire world of forms (length, the need for a widely extended rhythm, is almost a measure of the force of inspiration, a sort of counterpart to its pressure and tension). Everything occurs quite without volition, as if in an eruption of freedom, independence, power and divinity.”

In other, more numerous cases, there is a kind of collaboration between the conscious and subconscious. The work is started by an act of the will, and accomplished both by previously pondered efforts and by subsequent,

involuntary, spontaneous inspiration. With the man of learning especially, the subconscious work is usually produced only after a long period of conscious incubation. First come deliberate work, research, reflection, an effort to solve a problem. This effort does not give the solution. Then the discovery springs up from the depths of the subconscious, followed by fresh conscious labors to develop its consequences.

The collaboration of conscious effort and of subconscious inspiration produces the most perfect masterpieces. *Goethe*, poet, man of letters, philosopher, man of science, one of the greatest geniuses the world has produced, defines this happy collaboration in an admirable letter addressed to his friend, W. von Humboldt, dated from Weimar, March 17, 1832. We quote the following passage:

"Exercise, study, reflection, success and failure, encouragement and resistance, and then again reflection—all these have created a subconscious activity within us, which unites in a free understanding with our consciousness, in such a way as to produce a unity which surprises the world."

Henri Poincaré, mathematician of genius (1854–1912), relates the many vicissitudes attendant upon a discovery which exacted long and fruitless efforts, and was followed by sudden illumination:

"What first strikes you," he writes, "are those appearances of sudden enlightenment, the outward signs of long

and previous labor of the unconscious. The part which this unconscious labor plays in mathematical discovery seems to me to be indisputable; and traces of it elsewhere, where it is less evident, may be found aplenty. Often, in wrestling with a difficult problem, you accomplish nothing at the first attempt; you rest for a while, and then sit down at your desk again. For the first half hour you continue to find nothing; then, of a sudden, the decisive idea flashes through your mind. It might be said that the conscious labor was more fruitful because of the interruption, and that repose restored vigor and freshness to the mind. But it is more likely that this repose was filled with an unconscious laboring, the result of which later revealed itself to the geometrician during a period of conscious work, but independently of this work, the latter at most acting as a kind of motivator, as though it were the goad which stirred the results already acquired during repose, but still unconscious, to take on a conscious form."

Descartes, too, was visited by a flash of sudden insight after long and patient reflections. It was in 1619, at Neuburg, on the banks of the Danube, on the night of the tenth of November, that he finally became conscious of his method. In a sudden flood of enlightenment, as inspiration welled up from the depths of his subconscious, he distinctly perceived the new rules he must observe in order to envisage science; this discovery filled him with such joy that he vowed to make a pilgrimage of grace to *Nôtre Dame de Lorette*.

At times, these two faculties are concomitant, the conscious being present, so to speak, at the manifestations of the subconscious. Thus, *Tolstoy* writes: "It seems to me that a spring released in my brain suddenly allowed some sort of machinery to function, and ideas to follow upon each other, fleeting and bright as lightning. Thus an hour would pass, then two, without my ever noticing it. A dual personality is also produced, for the conscious ego, relegated unresistant to the background, is startled. There is the ego who creates; and another ego, who is so surprised at this urge that he believes a foreign will to be its cause."

This separation between the subconscious and the conscious is even clearer during sleep, when all consciousness is absent. *Sir Walter Scott* relates that he would often retire at night after having vainly sought an idea, and that it would greet him on awaking next day. *Schopenhauer* was very familiar with this phenomenon which he termed "unconscious rumination". And *Michelet*, the French historian, before retiring, would busy himself for at least a few moments with papers he had prepared for the morrow, thus setting in motion the subconscious working of the mind.

Voltaire relates that one night he dreamed a complete canto of his *Henriade* in a form different from that in which he had written it. This caused him to reflect: "In my dream I said things which I would scarcely have said

the previous day; I therefore entertained thoughts conceived despite myself, and without my having any part in them; I had neither will, nor liberty, yet I combined ideas with wisdom and even with a certain genius."

Condorcet, French mathematician and philosopher of the eighteenth century, stated that, after spending several hours in difficult calculations, he was often obliged to leave them unfinished and retire for the night. On several occasions, in his dreams, the problems solved themselves, and their corollaries came to mind.

Coleridge would fall asleep while reading; on awaking he would find that he had composed some two or three hundred lines of verse. He had but to write them down, as the images came into being like realities, with the appropriate expressions and no consciousness of effort whatsoever. The sum total of this singular labor was fifty-four lines written as fast as pen could write; but he was interrupted by a caller, who remained an hour on some business. Then, to his intense surprise and chagrin, Coleridge discovered that although he still retained a vague memory of the general content of his vision, it had receded far into the background in clarity, save for some eight or ten scattered lines.

The case of the French novelist, *Rosny*, is similar. Several years ago, this author used to lay a pencil and piece of paper by his bedside. He would often awake with a start and set down notes of great importance to his studies.

In another field, *Tartini*, the Italian musician, illustrates the same process. He composed his famed *Devil's Sonata* while he was asleep.

Thus, an author will fall asleep after having pondered his work. On the morrow, upon awaking, the subconscious having worked meanwhile, his ideas present themselves quite clearly and the solution of a problem appears ready-made.

A portion of the work, or the work in its entirety, still shrouded in darkness the night before, is thus created during the absence of the conscious ego. It is the man of the night who has done all, the man of the morning is but a scribe.

Further, the workings of the subconscious independently of the conscious may be observed in a man of genius even when his conscious ego has foundered in madness. Thus, *Schumann*, even after his affliction, still composed some very fine pages of music.

I have had the opportunity of observing the independent activity of the subconscious in another circumstance, namely, when a person is subjected to artificial slumber under the influence of some anaesthetic—chloroform or ether, for example.

The conscious first disappears, whereas the subconscious, in some people, continues active for a longer period of time, and for several seconds displays a very lively activity. With the disappearance of the conscious ego, and of its powers of control, the subconscious is stim-

ulated and brings forth secrets deeply buried in some centres of the brain.

Happily, this is not of frequent occurrence, but it is well that surgeons, like priests, are bound by professional secrecy. By the same token, as a matter of precaution, surgeons have adopted the custom of banishing such undesirable persons as a husband or wife, or a police officer, from the operating room during the administering of an anaesthetic.

In somnambulism, we have further occasion to establish, even more clearly, the existence of two psychical functions of the brain, each completely independent of the other. Does not sleep-walking display a complete cessation of the brain's conscious activity with a continuance of its subconscious activity? In inspiration, which is the fruit of the subconscious, it is as though a stranger were dictating to the author; in sleep-walking it is the stranger himself who takes to speech or pen, who talks, writes, who, in short, performs the work. Thus *Woehner of Göttingen* relates of his success in writing poetry in Greek during an access of somnambulism, whereas he had striven unsuccessfully to do so when awake.

Thus, too, the Greek historian, *Diogenes Laertius*, claims to have known a Stoic philosopher who, while sleep-walking, composed philosophical treatises, re-read and corrected them. *Zwinger* also records the case of two young men who with closed eyes would rise at night to write and compose. One translated theses from German

into Latin; the other was a professor of Greek poetry who, exhausted after attempting all day to compose, left the verses unfinished. What was his surprise on the morrow, when, sitting down to finish them, he discovered the whole work was completed, written throughout in his own hand.

Two further examples of somnambulism are worth quoting to bring out the fact that the subconscious can take control of acts to the total exclusion of the conscious ego.

A somnambulist was in the habit of placing a gold-piece in the same place in his room every night. As piece after piece disappeared, he suspected his daughter, the only person living with him. He remonstrated with her repeatedly and vainly, and finally drove her out of the house. But the goldpieces continued to vanish. One night he awoke with a sharp pain in one foot; he lit his lamp, examined the sole of his foot and found a piece of glass in it. The mystery was now clear. Fragments of broken glass lay on the table. He must therefore have climbed on it during his sleep. From that position he had deposited all his goldpieces on a shelf; and there they stood, row upon row.

Impressions received during the somnambulistic activity of the brain did not affect that organ's conscious activity, which was paralyzed for the time being. On its return to consciousness, therefore, the ego had no knowledge of

these impressions. But upon the occurrence of a fresh access, these impressions, possessed by the subconscious alone, once more came to life, and led the individual back into the circle of his automatic dreams, so that he was invariably able to set the goldpieces in the same place.

The second example I quote will serve to illustrate how the brain's subconscious activity can function alone for a very long period of time, and how, upon the reappearance of that organ's conscious activity, the ego has no knowledge of very complex actions performed during somnambulism.

Miss X, aged 20, a member of a highly respected family, had retired at ten o'clock in the evening. Her mother entered her room shortly afterwards, only to find that her daughter was no longer there, and had, indeed, left the house. The maid-servant stated that she had seen her leave the room half-dressed. Most of her clothes were neatly folded on a chair. She must have gone out of doors in an old skirt and the maid's coat, with only a band around her head, and she must also have taken some money with her. All search in town and suburbs proved fruitless, though rumor offered various clues. For instance, a girl, apparently a street-walker, had been reported in a distant quarter of the town. Then a woman appeared, testifying that the same morning, in a town fifteen miles away, she had seen a girl who behaved somewhat strangely. The girl was known to have bought a pair

of stockings and a straw hat in a store, to have gone to a small café nearby for a cup of coffee, and then to have vanished.

The evening following Miss X's disappearance, a seamstress in a town thirty miles away from Miss X's residence, was praying in church at nightfall. A young girl entered, poorly clad and apparently so deeply plunged in meditation as to be completely oblivious to everything around her. She remained on her knees in the church for some time, and finally the seamstress approached her, with the remark that the church was about to be closed and that they must leave. The other informed her that she had come to town in search of domestic service; that she was a stranger, and did not know where to go. The seamstress offered to put her up for the night, an offer the girl promptly accepted. Next morning, the seamstress entered her room with a newspaper, which carried a pathetic description of the anguish of Miss X's parents at her disappearance. Hearing her name, the girl seemed to awake with a start. "But I am Miss X," she cried. She knew nothing of what she had done during this fit of somnambulism, which had lasted over thirty-six hours, and she was dumbfounded to find herself away from home.

I have just described the various aspects in which the subconscious reveals itself. There is no doubt of its reality. It constitutes an entirely independent psychical faculty, beyond our consciousness and our power to control. How, therefore, can we possibly assign to it the same place in

the brain occupied by our consciousness, our reasoning, our reflections, in short, by the mind which guides us in the normal circumstances of life? Where, then, can it be placed?

Observation of what occurs upon the administering of chloroform or ether might, I think, solve the problem. It is the conscious ego which first falls asleep, followed at an interval by the subconscious. Now, in the brain, or, to be more precise, in the grey matter which covers the two hemispheres of the brain, the superficial layer is not only very rich in blood-vessels, but it is also in direct contact with the highly developed vascular network of the envelope covering the brain. On the other hand, the middle and lowest layers of this grey substance are traversed by much narrower vessels. The anaesthetic fumes reabsorbed by the blood certainly enter the superficial layer of the brain first and in large quantities. Consciousness then disappears with all its indices—sensation, movement, and so forth. The middle and lowest layers are reached several instants later, when the anaesthetic has penetrated them in turn. The subconscious, in cases when it has been manifesting itself, now also falls silent.

From these facts duly observed, which may be likened to facts duly experienced, we may conclude that the conscious ego occupies the superficial layer of the brain, and the subconscious the lower layers. The brain would thus seem to possess two distinct regions capable of functioning separately: the one—the conscious part which we can,

if necessary, master and direct by means of our will; and the other—an area which completely escapes our control and which appears within us in the form of inspiration, illumination and revelation.

Not only are we not its masters, but it can take possession of us and guide our acts unbeknown to our consciousness, without leaving the slightest memory. The subconscious constitutes a second personality within us, a personality which, in the case of somnambulism in an author, is capable not only of conceiving ideas and solving certain problems, but of actually using the author's own hand to set down its findings, without his remembering anything of what has occurred. The miracle is that what the hand has written at the dictation of the subconscious is always infinitely superior to what it would have written when guided by the conscious ego. The subconscious is the sublime functioning of thinking cells residing in the deepest layer of the grey matter of the brain.

In the case of genius, these cells radiate the profoundest thoughts of philosophers, the loftiest flights of poets, the proudest creations of artists, the noblest discoveries and inventions of scientists.

CHAPTER VI

THE CREATIVE PROCESS IN POETS
AND WRITERS

The conscious is not a creative force. Inspiration alone discloses to the man of genius the treasure of thoughts elaborated by the subconscious. The conscious can tend towards a literary pattern, an artistic vision, a scientific problem; it can begin the work, and must even, for the most part, execute it. But it is inspiration which, at the given moment, furnishes the required solution, and endows the work with its greatness and originality.

This is as true of the poet in the silence of his study as it is of the general in the turmoil of battle. Did not *Napoleon* write: "The fate of battles hinges upon one moment, one hidden thought; the decisive moment appears, the spark is fired, and victory is grasped." Unfortunately, inspiration is capricious and does not always come at the desired time, the opportune moment. . . .

Writers and artists know this so well that they always carry a notebook with them in which to jot down, at any moment and under any circumstances, whatever inspiration may whisper to them: the poet—a few lines of verse, the thinker—a philosophical postulate, the scientist—the long-sought solution of a problem, the critic—a well-turned passage, and so on. Always and everywhere they

are on the alert for beneficent inspiration, ready to capture it either in solitude or amid a crowd, in the quietude of their couches or on a train journey, in the midst of a social gathering or alone, in the course of a commonplace conversation to which they are inattentive and to which they contribute but monosyllables.

The conscious has, however, its part in the work of creating. All art, as well as science, entails a certain knowledge, a special education, a technique which varies with the medium in which the man of genius works and which he has mastered after long preparation.

From this point of view, poets are to be reckoned among the most fortunate of artists. They have little to learn; the technique of rhythm, the beauty of style come easily to them. Genius is everything, and love stimulates and exalts them, dictating their most beautiful works. Love and poetry are inseparable; poets are eternal lovers. Their gift is bound up with the hypertrophy of a brain centre of speech, the Broca centre, in the left hemisphere of the brain. Close to this seat of the exteriorization of thought are sensitive centres of a clearly defined sexual character, bound together by nerve filaments. The functional similarity of these two centres, the reciprocal action of these two cellular groups, one endowing the poet with splendid language, the other influencing his amorous sentiments, frequently explains the genesis of poetical works. The fusion of genius, the burning work of inspiration, and soaring sexuality is found in the majority of poets. *Gabriel*

d'Annunzio has recently supplied us with a brilliant example.

Literary production is often entirely the result of subconscious workings, of inspiration. *Lamartine's* facility was miraculous. Did he not himself one day remark to a friend of his who was absorbed in work: "What are you doing there, my friend, holding your head in your hands?" "I am thinking," came the reply. "Strange!" *Lamartine* rejoined, "I never think, my ideas think for me."

Goethe, for his part, said: "I let objects act peacefully upon me, later I observe that action, and I hasten to render it faithfully; this is the whole secret of what men have agreed to call the gift of genius."

In many cases, ideas germinate profusely, images succeed one another, and the writer is overwhelmed by a torrent of thoughts. *Balzac* was wont to declare that two more brains would be necessary in order to execute what his own proposed: "I have more ideas than I can hold," was the way he put it. "More words come to me than I can write."

The poet's work springs from two wells; he creates with the subconscious and writes with the conscious. The harmony between these two, the intimate coupling of inspiration and of its acceptance by reason, produces immanent beauty.

Generally, the conscious elaborates or rather begins a work, forms a project, evokes a situation; but for all its efforts, the limitations of its deliberative capacities do not

allow it to carry the work to its successful conclusion. Unless inspiration comes to the poet's assistance—and he is not master of his inspiration—if he persists, he will produce only mediocre work which he will later reject. If he is wise enough not to insist, some other day he will find his abandoned work finishing itself off as if by magic. That time which had seemed to him to be lost will in reality be gained; the subconscious will have pursued the task in silence, brought it to fruition, and offered it all of a piece.

The writer senses perfectly whether or not he is inspired. If he is, the work comes easily, joyfully, enthusiastically, with a feverish exaltation. If not, he experiences not only an intellectual but also a physical weariness, painful efforts, a feeling of impotence, melancholy, depression. He must not insist; he must await the whim of inspiration.

Goethe, in a letter to von Humboldt on the subject of his *Faust*, which, with interruptions and intervals, busied him for thirty years, wrote:

"The difficulty has been to make will-power achieve what can truly be obtained solely by a spontaneous act of nature."

On the other hand, once inspiration has come, it must not be frightened away by the cold criticism of reason, even if it does appear somewhat disconcerting.

Schiller has this to say about it: "It would seem wrong and harmful to creative labor to let the intelligence censor too closely the swarm of ideas which arise, and already

stand at the portals of the conscious. An isolated idea may be without import and quite haphazard; but it may gain substance when considered in connection with others, which themselves also seem to lack taste; and all, taken together, form a coherent whole. The understanding is incapable of judging this, unless it retains ideas long enough to perceive them in their relation to other ideas. In the case of a creative spirit, it seems to me that understanding no longer watches at the gates, that ideas rush in headlong, and that understanding sees and approves them much later."

In fact, in the most remarkable cases of collaboration between conscious and subconscious, it seems that the work consciously begun is entirely elaborated in the subconscious, together with a definite plan; but the parts of this plan, and the various details, come to the consciousness little by little, one by one, and in no regular order. The work must have reached a very advanced stage before the plan and the ordering of its parts are gradually revealed. It is then that the writer, suddenly conscious of all this subconscious effort, must re-establish the harmony of the work. This work may now appear quite different from the initial outline; it may give the author an impression of beauty utterly beyond his capacities. His first feeling on contemplating his work is one of surprise. He is under the impression that it was done spontaneously, within himself, that he received it rather than gave it.

"One does not write the books one wishes," said *Edmond de Goncourt*, the French writer (1822-1896). "There is a fatality about initial luck, which dictates its idea to us. Then an unknown force, a superior will, a sort of necessity to write, prescribe the work and bring you your pen, so much so that the book which comes from your hands does not seem to proceed from yourself. It astonishes you, as though it were something within you of which you had no knowledge. That is the impression I gather from *Soeur Philomène*."

When inspiration guides the poet's pen, a cogent emotion generally results. It is a moment of crisis, of exaltation. With *Alphonse Daudet*, the fever of composition originated in an intense emotional state: "Under the power of evocation which this emotion exerted, facts grouped and ordered themselves."

A considerable change of ideas, an important creation, almost inevitably imply a period of disturbance and agitation. The author lives with his characters, he assimilates them, he thrills to their joys, and he shares their sorrows. *Balzac*, writing *Père Goriot*, furnishes us with a striking example. In the throes of composition, his personality would split. He escaped, as it were, from his own nature, and entered the envelope of another.

He became *Père Goriot*; he was no longer *Balzac*, he no longer felt his own bulky person. He communed so deeply with the silence of the night about him that illusion visited him easily. He would find himself on a sick-

bed in the Pension Vauquer. Balzac-Goriot would pant and call out: "My daughters, I want to see them. Have the police send for them! Justice is on my side! Everything is on my side, nature, the law!" As he wrote, his pen scudding over page on page of foolscap, he would rasp in the raucous tones of a throat rattling in death: "Oh, they will come . . . come, my darlings . . . come once more and embrace me, one last kiss, the last sacrament of your father who will pray God for you, who will tell Him that you have been good daughters, who will plead for you."

Balzac stretched himself out on his pillows, breathed deep gasping breaths of the old Goriot, and rolled ghastly eyes around in their sockets. Suddenly softened, yet a moment later curling his lip into the most horribly bitter sneer, he attempted a smile which was a supplication. His two friends, Bianchon and Rastignac would loom beside the bed from which he wrote; he could actually see them moving. "After all, you are innocent," he moaned, "they are innocent, my friend." The hallucination was so complete that he uttered this whole sentence without thinking of setting it down on paper. Groans followed, with Balzac wagging his head over the bed, just like his poor devil of a hero.

Still speaking and whining, his pen would race across the page, this time at such speed that he did not even look at what he wrote, lest he impede the inspiration, scribbling only the first few letters of each word.

"It is all my fault," he sighed. Then, sobbing, "I ac-

customed them to trample on me." He uttered a despairing cry: "*I liked that!*" Suddenly he screamed: "Write them that I have millions to leave them!" With trembling hand (the hand holding the pen) he motioned: "Go, write quickly."

The pen clawed the paper; the writing, at first very close, now gained such speed that ten scrawled lines covered a whole page. "A drink, a drink," cried Balzac-Goriot, "my head is a wound, my bowels are afire. Oh . . . Oh . . . put something on my head! The hands of my daughters—that would save me!" At last, he felt he was dying. In order to die, he dropped his pen, which rolled to the floor, he stretched himself out like a man racked with suffering, he extended his arms on either side of his bed, with Bianchon and Rastignac still looming over him . . . and then he suddenly turned into Balzac once more. The feeling for art and the joy of the artist came back to him, and René Benjamin, who records this scene, adds that Balzac completed his novel in the short hours of the night remaining; so, he continued to merge himself in the obscure forces of nature, partaking of two worlds at once, breathing in the one, seeing in the other, creating in this one, writing in that.

Balzac immersed himself so completely in the lives of his creatures that at times he would stop writing in order to go to the door to receive a caller—a caller who was none other than some character of fiction destined, in the novel being written, to make his entrance at precisely that point.

The incarnation of the writer in the personages of his novel and his sharing of their lives are frequent phenomena; they constitute the real hall-mark of the genius. The conscious holds the pen, the subconscious dictates the joys and anguish, the passions, the suffering and the happiness which it creates.

Genius is a vision, a divination of the intimate life of human beings; therein lies the greatness of its work.

CHAPTER VII

THE CREATIVE PROCESS IN COMPOSERS

Musicians and composers of genius owe their gifts to the anatomical predominance of a group of brain cells which contribute to the formation of the auditory system. They are born musicians, but, more than poets do, they need the technical education which no musical genius can forego. They play various instruments, so to speak, on coming into the world; but perfection requires study of the masters of their art who have gone before. Solfeggio and counterpoint must be learned, the theory and principles of composition must be mastered, the ability to arrange orchestration in accordance with the laws of harmony must be acquired.

Bach used to copy stealthily, by moonlight, pieces for the clavier by Bamberger, which his brother had refused him, saying they were too difficult. *Mozart's* earliest teacher was his father, first a violinist in the Archbishop of Salzburg's orchestra, later a composer and conductor of the Prince Archbishop's court orchestra. *Wagner* learned the elements of counterpoint and harmony with Gottlieb Müller, but the organist-pedagogue and cantor at the Thomasschule, Theodore Weinlig, was his real teacher. He taught him to modulate the themes crowding

in his mind, to analyze and to develop them, to write them in fugue or in canon.

All art, moreover, implies a craft whose most general rules have been elaborated gradually through the centuries. These are truly mastered only when they may be applied without effort, when they have become the instinctive form of thought and action. Music is the artist's language, a language whose realm surpasses the bounds of the spoken or written word. The impressions that range through a composer's brain move it deeply, set it in motion, and emerge in the form of a musical composition.

Weber, contemplating a landscape near the waterfalls at Gerolsau at the hour when the moon made silver of its rushing, turbulent waters, transformed the scene into one of the best parts of his *Freischütz*. The composer thinks and feels in music. The hypertrophied auditory centre predominates in the brain. Every impression terminates in the auditory centre; in it, all human feelings find their echo; love, hatred, happiness, betrayal, sorrow, melancholy, joy, compassion, pity, prayer, adoration, everything is transformed into sound, just as, with poets, everything is transformed into speech.

Schumann, at the age of eight, delighted in improvising musical sketches which described his young playmates, reproducing their moral characteristics and even their physical appearance, by means of divers turns of songs in varied rhythm. At times the resemblances were so striking that without further designation everybody

recognized the physiognomy outlined by the novice fingers of genius. Later, he remarked: "I feel myself affected by all that happens in the world, men, politics, literature; I reflect upon it all in my fashion, and it finds an outlet in the form of music. That is why so many of my compositions are so difficult to understand; they refer to events of remote, though important interest; but everything in this era which strikes me as remarkable, I must express in music."

With the composer, as with all geniuses, the subconscious and its inspiration play the major part. The musical idea, which is often spontaneous, sometimes expresses itself gradually after latent labors; at other times, it brusquely invades the conscious, which has but to note it down. More than any other musician, *Mozart* showed how musical sensations gave a kind of cohesion to his mentality. In one of his letters, he himself analyzed the spontaneous and miraculous creation of music within himself:

"When I feel fit and in good humor," he said, "or when I travel by carriage, or take a walk after a good meal . . . thoughts crowd in upon me with the greatest ease. Whence do they come? I know nothing of it; it is not my doing. Those which please me I keep in my head and I hum; at least, so I am told. As soon as I have retained my air, another comes along to join it, fulfilling the needs of the entire composition, counterpoint and play of the instruments. All these detached pieces finally make up the pie. My soul is then afire, unless something comes to dis-

turb me. The work grows, I continue to hear it, I make it ever more distinct; at last the composition, however long, is completely finished in my head. I then take it in at a glance, like a fine picture; my imagination made me hear it, not successively, in the detail of its parts as happens later, but as a whole, in its entirety. What a delight! All of it, the invention and the execution, lose themselves in me as in a beautiful, very clear dream. How, during my work, do my compositions take on the form or the matter which characterize Mozart and resemble no other man's? Well, that happens just as my nose happens to be large and hooked, the nose of Mozart, in fine, and no one's else. I do not aim at originality; if asked to define my manner I should be at a loss. It is quite natural that people who really have a particular look about them should appear as different outwardly as inwardly."

Such was not the case with *Chopin*. Creation to him was equally spontaneous and miraculous; he found it without seeking or foreseeing it; it came of a sudden, sublime. But Georges Sand adds: "After the crisis, the most heart-rending work which I have ever witnessed began," and she describes him day-long, week-long, pursuing with anguish the shreds of his vanished inspiration.

More than any other creation, the work of a composer of genius is entirely the work of his subconscious. The technique, the rules of harmony, the conscious effort of a gifted and talented musician can produce a charming,

agreeable work; but only genius creates beauty, grandeur, an immortal work.

For the musical genius, the world of sound is his whole life, his entire reason for being. *Beethoven*, stricken with deafness, driven from the world of sound, which for him meant everything, was desperate. He wanted to die. What stopped him was *Fidelio*, the *Symphony in A Major*, *Symphony with Chorals*, the joy of raising an immense and powerful voice to pierce the shadows of deafness and to intone the hymn of fruitful suffering, of action and of liberty.

“Art alone held me back; it seemed to me that I could not leave the world before having produced all that I felt within me.”

For a composer of genius, to create music is to live!

CHAPTER VIII

THE CREATIVE PROCESS IN SCIENTISTS

In making a discovery, relative ignorance, strange as it may seem, is sometimes more useful to a man of science than deep learning. In every period, science contains a certain number of theories which pass for unassailable and final truths; to question them would be a sacrilege. The scientist who knows them all, who has made them his own, whose brain is encumbered with all the facts accumulated for their corroboration, will never invent anything. There are scientific discoveries and industrial inventions which could never have been made had we stopped at prevailing and reputedly unshakable dogmas. Frequently, the inventor was the more untrammelled for being ignorant of them. Then, since the *fait accompli* had to be recognized, the theory would be broadened to encompass and explain the new discovery.

In every branch of science, the fundamental knowledge must be acquired; but excessive erudition kills the imagination, clutters up the brain with dusty details, and dissipates the courage necessary to take a step forward. Tenets which are almost invariably accepted without criticism and have become a fixed idea, are eminently opposed to invention, as *Claude Bernard*, French physiologist,

ogist of the nineteenth century, remarks: "As a matter of fact, a discovery is generally an unforeseen connection not to be found in the theory, else it would have been foreseen. In this respect, an ignorant man, unacquainted with the theory, would be best conditioned, since the theory would not obstruct him nor prevent him from seeing new facts invisible to one who was exclusively preoccupied by theory."

Pasteur, one of the supreme geniuses born to humanity, affords us striking proof both of the danger of submitting to a prevailing doctrine, and, in certain cases, of the advantages of ignorance. The following took place on two different occasions: Pasteur was vainly seeking the lactic ferment. In all his experiments he could readily descry the presence of small infusoria, but he carefully discarded them, for according to the prevailing doctrine which he, like all contemporary scientists, had accepted, ferments were vegetable and not animal. Now, infusoria are minute animals, and therefore might not be considered as ferments. Pasteur fortunately possessed a powerful mind which could not long remain blinded by theory; eventually he realized that it was precisely those small infusoria he had wished to discard which constituted lactic ferment. His excessive confidence in the prevailing doctrine caused him the loss of precious time, and his discovery brought down upon his head a storm of polemics as impassioned as it was stupid.

In another instance, his ignorance facilitated a discov-

ery. In 1865, he was requested by Senator Dumas to make a study of disease in silk-worms in the south of France. Pasteur knew nothing of the subject; he had never even seen a silk-worm. He therefore declined the offer, pleading his complete ignorance. Dumas replied: "So much the better, your only ideas will be those resulting from your observations." And Dumas was right. To make the discovery sought for, Pasteur's genius sufficed.

The greatest advance in surgery was made in the sixteenth century by a barber-surgeon, *Ambroise Paré*, who happily knew no Latin and was therefore unable to digest all the dogmas which at that time held sway in that field. With the audacity of ignorance, unrestrained by scholastic learning and guided solely by his genius, he dared to tread new paths. Instead of pouring boiling oil on the wounds of an amputated person in order to stop the hemorrhage, as was then the practice, he obtained the same result by binding the arteries and veins, thus sparing the wounded person horrible suffering.

For thirteen years *Newton* abandoned his genius-inspired hypothesis of universal gravity, because it did not correspond with the measurement of the terrestrial meridian then generally accepted by scientists. It was only in 1682, as a result of the research of the French geometrician, *Picard*, that this measurement was recognized to be false. Relying on the new measurement provided, *Newton* revised his calculations, which agreed perfectly with his theory of gravity.

Of prime necessity to the scientific inventor is the autonomy of thought, the tendency to judge everything separately, succinct in the famous rule of Descartes: "Admit nothing as truth, unless clearly recognizable as such."

Another obstacle to discovery is excessive specialization. It engenders routine, closing the mind to the unexpected relations nature affords between more or less distantly separated things. This does not mean that specialization, in the present state of science, has not become necessary if a subject is to be closely and deeply studied; but such specialization should be left to a certain type of professor, wardens of science, but never destined to be inventors. They are living libraries, most useful to students, but, withal, specialized enemies of any discovery in the particular field of science which they know thoroughly and which they have barricaded.

Thus, *Claude Bernard*, genius in the field of physiology, discovered that the liver produces sugar, an axiom which students now learn on the school bench. Yet Claude Bernard had to struggle twenty years for the acceptance of his discovery. It would have sufficed to think of diabetics, who produce sugar without eating any; but, to a man, the professors and the entire Academy of Medicine were opposed to this discovery. Even the clear, precise, experimental demonstration which Claude Bernard made of his discovery did not avail to convince them, since the ruling theory dogmatically proclaimed that only vegetable matter could produce immediate principles, and

that animals merely assimilated them. It followed that animals could not produce sugar, since it was vegetables which did so for animal consumption. And this folly took place in the nineteenth century! The theory being sacrosanct, any fact advanced in contradiction to it must necessarily be false. The death of most of Claude Bernard's academic opponents, who by good fortune were well on in years, had to be awaited before the survivors finally recognized that he was right.

A sacrosanct theory was also advanced to oppose my discovery of rejuvenation. When, after hundreds of grafting operations upon animals which the French government had placed at my disposal in Algeria, and upon those which I had assembled in my laboratory at the Collège de France, I showed that an old animal could be rejuvenated, and for some years restored to the vigor and energy of youth, I was met with the prevailing theory of the non-reversibility of age. Nevertheless, the animals were there, the change in their aspect and in their attitude was striking, the renewal of aptitudes which disappear with age was manifest. But nothing availed, not even the birth of offspring, engendered after grafting by animals previously completely incapable of this function. Opposition ceased only after a committee of scientists appointed by the French, English, Italian, Spanish and Czechoslovak governments, had gone to Algeria, verified the results obtained (November 4, 1928) and published the reports they made to their governments. It took eight

years of struggle to convince the scientists that bulls do not lie, nor in their old age and decrepitude, resort to artifice in order to appear young and vigorous, and that sheep do not employ cosmetics in order to lengthen, thicken and enrich their wool.

Discoveries have always, at every period, been fought by official representatives, the repositories of instilled and definitive science.

In general, the point of departure for scientific discovery is observation of a fact. For Newton, it was the falling of bodies to the ground; for Darwin, the similarity of the gigantic fossil of an armadillo and the small existing one; for Denis Papin, a French physician working in the seventeenth century, the raising of the cover of a pot of boiling water, and so forth. These simple facts enabled Newton to discover the law of universal attraction, Darwin to formulate his evolution of species, Papin to conceive the idea of the steam engine. Thousands had seen these phenomena without reacting to them in any way. It is the attribute of genius, through sudden inspiration, promptly to conceive a theory of general application. A fact may even stare scientists in the face for a long time without inspiring them; then, suddenly, comes a ray of light, the mind interprets the same fact quite otherwise, and sees it in entirely different relationships. Swift as lightning, the new idea flashes through the brain as a kind of sudden revelation. Actually the discovery proceeds from a perception of things which is not only subjective,

but even related to the mental state of the moment. Inspiration does not pay a daily visit to scientists and poets of genius; but it visits them alone.

There are no rules for the discovery of fruitful and luminous ideas whose brilliance dissipates the shadows of facts and opens up new paths. They are the product of genius, of sudden inspiration. With the conception of the idea, the formulation of the theory, the period of incubation begins. This latter period lasted seventeen years in the case of Newton. When he came to the point of definitely establishing his discovery by calculation, he was so overcome by emotion that he had to entrust the task of completing it to another.

Various phases form links in the chain of a scientific genius' work: first, the observation of a fact; then, the formation of the hypothesis brought about by an inspiration; and finally, the interposition of the reasoning power to verify and justify the hypothesis. Reason transforms the work of the imagination into acceptable and logical consequences. Even when a problem seems to progress of its own accord, the imagination intervenes nonetheless, unceasingly, in the shape of a succession of gropings, trials, conjectures and possibilities which it suggests. The function of reasoning is but to determine the value of all the suggestions advanced by inspiration.

The French physiologist, *Beaunis*, describes a somewhat different process where the hypothesis precedes the observation of facts. "At a given moment, without my

knowing why, and often when I would least be thinking of it," he observes, "the mother-idea, as I call it, would come to my mind. In other words, this idea, having once entered my consciousness, gives birth to a series of secondary ideas, which are, in a manner of speaking, its flowering, and which constitute the work itself. This flowering is subject to my will; it is produced and it develops under the influence of a mental activity of which I am conscious and which I direct as I will. But such is not the case with the 'mother-idea'; it springs into my mind without my having any part in its appearance; it is a spontaneous hatching, about which the most minute introspection teaches nothing; it springs from the depths of the unconscious, and it offers the material upon which I work with my mental, conscious and voluntary activity."

There is, indeed, a very sharp dividing line between the interposition of the hypothesis which is the working of genius, and the establishment of that hypothesis which depends upon the reason, upon facts experienced, and upon consecutive observations. Inspiration suggests the idea, but often, in order to give it body and consistency, laborious preparation, perseverance and a readiness to face the hardest tests are imperative. The practical means requisite for the execution of the labor, for making the discovery or invention workable, must be examined and re-examined in all their aspects.

This holds equally true for scientific, as for mechanical and instrumental inventions, which utilize natural forces

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by means of devices unknown to nature. In science a great work is only created by the association of a lofty inspiration and a powerful intelligence.

The price of humanity's progress is genius and work.

CHAPTER IX

THE CREATIVE PROCESS IN MATHEMATICIANS

I shall devote a special chapter to mathematicians of genius, whom I particularly admire. They are the most fortunate of men. Their brain alone suffices, provided that nature has endowed it with genius. The handling of figures scarcely requires long preparatory study; a knowledge of the fundamental rules of mathematics offers them ample matter upon which to formulate the most daring hypotheses, and to reach the most brilliant solutions. Astronomers, who also deal in figures, must observe the stars, follow the movement of planets, watch for the appearance of comets, and so forth. But mathematicians have no traffic with nature or anything else; their sole concern is figures, which furnish them with powerful means to solve the thorniest problems.

Mathematical invention is the act in which the human mind seems to borrow least from the external world. It functions only through and upon itself. We are amazed when we consider the conscious and subconscious intellectual faculties of certain mathematicians of genius. Do not their calculations, based on the law of universal gravity which ensures Earth's equilibrium, permit them to estimate the distance between sun and Earth, and be-

tween the various planets? They showed us that between Earth and sun there is an interval of some ninety-three million miles, that the planet Mercury, the sun's nearest neighbor, is thirty-six million miles distant from the sun, and so on. They also calculated the weight of the earth, the sun and each planet. Thus we know that Mercury is sixteen times lighter than Earth, that Venus is one-fifth lighter than our planet, that the moon is eighty-one times smaller, and Jupiter three hundred and ninety times heavier, and the sun, three hundred and twenty-four thousand times larger. By their calculations, they were able to determine how many years or centuries it takes for light to travel from a given star to us, as, for instance, the nearest, which reaches us in fifty-two months. The skies hold no secrets for them, and they need not even eye them.

The story of the mathematical genius, *Urban Le Verrier* (1819–1877), is noteworthy. An oddity in our solar system, the planet Uranus, unequal in its course and not conforming to formulas, belied the calculations of astronomers. Now late, now early, for its appointed appearance according to the laws of gravity, it seemed, to the despair of astronomers, to contradict their accurate findings. Le Verrier, apprised of this aberration, assumed that the error was not to be ascribed to Newton's law, but to our ignorance. He, therefore, postulated the existence of a planet never before seen or suspected. This imaginary

planet, he argued, must by the laws of gravitation influence the course of Uranus.

In 1864, having followed this genius-inspired idea to its logical end, Le Verrier was forced by his calculations to recognize the real existence of a new planet, to plot its most probable position, to locate its range, actually to determine its weight, the width of the disc under which it was visible, and its distance from the sun. He was vindicated when the astronomers, adopting his calculations, established the presence of a new planet, seventeen times greater than Earth, and dubbed it Neptune. The astronomers, delighted, called upon Le Verrier to announce the great discovery, and to invite him to gaze upon this planet, discovered as a result of his calculations. The mathematician declined: planets did not interest him. The magic of figures and the power of mathematical calculations were enough; material proof was powerless to add to his satisfaction.

Henri Poincaré even tells us of the important part emotion plays in mathematical discovery. "You may be surprised to hear of emotion cheek by jowl with mathematical demonstrations, which would seem purely intellectual. But you must not lose sight of the inherent *beauty* of mathematics, the harmony of numbers and forms, the elegance of geometry. You must allow for the truly aesthetic feeling which all real mathematicians experience; it is pure sensitivity."

In fine, all mathematical invention is due to inspiration, to the suggestions of the subconscious; later, a second period of labor begins, carried on by the conscious ego, since the results of inspiration must be elaborated, their immediate consequences deduced, they must be ordered, and their demonstrations must be drawn up.

This process is sometimes reversed. The mathematician, seeking a general method which he dimly suspects but which he cannot apprehend, may spend years of labor upon calculations intended to define it. So long as inspiration does not visit him, the solution escapes him. Technique and skill prove sorry means for ascertaining great ideas and brilliant solutions. And yet this long preparation has its uses. At length the straining of the mind in a given direction, and ceaseless activity of thought, stimulate the secret workings of the subconscious; inspiration finally crowns the labor with an appropriate solution.

The great Scottish mathematician, *Sir William Hamilton*, once experienced a revelation near Dublin Bridge. His famous method of quaternions suddenly flashed upon him. At last, after fifteen years of toil, he possessed the key to the riddle.

Inspiration once and forever determines the discovery, whether initially or conclusively, after a lengthy period of patient research.

CHAPTER X

THE INFLUENCE OF STIMULANTS AND EXCITANTS ON CEREBRAL ACTIVITY

A being truly endowed with genius is a slave to his genius. To manifest it becomes a need and a necessity which he can no longer control. Poems are written, music is composed, paintings are produced, and scientific problems attacked, because their author could not do otherwise. To fail to exteriorize what haunts the mind, to fail to respond to an appeal which surges from the depths of the soul, makes for intolerable suffering. The man of genius creates for the sake of his own happiness, his own joy in living. He therefore exacts an intense effort from his brain.

The growth of intellectual activity implies an increase in the work of the brain cells, and, consequently, a state of congestion in these cells. There is a direct relation between the speed of the blood's circulation in an organ and its functional capacity.

Spiritual and material elements are linked up in the brain. The more compelling a thought is, the greater the brain's congestion. During the work of creation, the pulse is slight and contracted, the skin is pale and cold, the head burns, the eyes are brilliant and dilated.

The tendency to prepare the brain for intense work, to stimulate it by congesting it, the better to dispose it for the great effort about to be demanded, is frequently found among writers. Thus, Schiller, while writing, would keep his feet on ice. By diminishing the circulation of blood in his feet and legs, he believed he would increase to that extent the quantity of blood flowing to the brain. André Grétry, French composer of the same period, used to do the same thing. To the same end, in the seventeenth century, Bossuet had been wont to stand in a cold room and to cover his head with hot linens or with furs. The heat thus generated seemed to him to help him in writing his sermons.

Descartes, Gottfried Leibniz, Milton, Rossini, Charles Thomas, and, closer to our own times, Paul Bourget, were in the habit of lying down under piles of blankets in order to meditate. Milton's verse, the philosophical concepts of Descartes and Leibniz, the psychical analyses of Bourget's heroes, the music of the operas of Rossini and Thomas were conceived by an artificially induced increase of warmth in the head. That was what they believed, at any rate, and the confidence they placed in these harmless devices could only facilitate their work. Giovanni Paiselle, Italian composer, relied upon the same procedure to compose; he would remain buried under veritable mountains of blankets. Rousseau, before writing, would bare his head to the sun. All such tricks aimed directly at increas-

ing the circulation of the blood in the brain at the expense of the body as a whole.

Other artists and writers believed that they could best condition themselves for work by surrounding themselves with agreeable perfumes. Rousseau used to maintain that certain odors inspired him. Huysmans actually supplies a description of the scale of fragrances and their value as intellectual stimuli.

Still others sought to heighten their capacity for work by improvising an outward pomp, and a stage-setting favorable to cerebral excitement. Thus, Buffon, French naturalist of the eighteenth century, would put on ceremonious apparel before writing, and the Italian painter, Guido Reni (1575-1642), painted only when gorgeously clad, the centre of a group of admiring students, respectfully waiting upon him. Others, again, sought pleasant visual sensations to spur their efforts. The French poet, Gerard de Nerval would write only in pearl-grey clothing, d'Annunzio in a chapel specially built for that purpose, Eugène Sue (1804-1857) with precious metals strewn about him. Scholars, on the other hand, as for instance, the French philosopher, Félicité Robert de Lamennais, and Tycho Brahe, Danish astronomer, are apt to seek silence and even confinement.

These devices are all artificial, to be sure, yet they are harmless. The contrary is true when artists and writers resort to certain substances, some of which are downright

poisons. These stimulants may, in the beginning, prove wholly effective; but, in the end, they invariably destroy the health of their user and annihilate his genius. I refer to alcohol, cocaine, opium, hashish.

Before dealing with these stimulants and drugs, I should like to set a place apart, the place of honor, for an intellectual and emotional stimulant more powerful than any I shall study in these pages. For is not love the most marvelous stimulant to thought and inspiration?

It exalts genius, breathes into it the ecstasy of creation, as hosts of poets and writers testify. For each great work, *Goethe*, a *savant*, a poet, a philosopher, a passionate character, required a new passion to sharpen his sensibilities and to set his brain pulsing. Throughout thirty years, these various and violent passions enabled him to carry on his immortal *Faust*. His first truly lyric flight, his first masterpiece, *Welcome and Farewell*, is due to his idyll with Frederika Bryon, whom he met at the age of twenty-one. *Werther* is the result, no more, no less, of his stormy passion for Charlotte Buff. Love exalts his spirit, prompts him with magic accents:

"Oh, what fire burns through my veins," he cries in the Twentieth Letter of *Werther*. "When by chance my finger grazes hers, or when our feet meet under the table! Hastily I start back, as from a consuming brazier, and yet a secret force draws me closer to her, for all I can do, so great is the delirium that sweeps my senses before it. When, in the course of conversation, she lays her hand upon mine;

when, interested in a topic, she draws so close to me that the heavenly breath from her mouth skims over my lips, I am as though thunder-struck, I am a man undone. I never know what state I am in when I am by her side; it is as though the soul poured forth its riches throughout my every nerve."

Even when Goethe was past sixty, it was still love that stimulated his genius. In 1823, when he was 74, he fell head over heels in love with Ulrica von Levetzov, a girl of seventeen. Through this love he returned passionately to the lyric springs of his genius. About to leave Marienbad to seek aid of the Duke of Saxe-Weimar—the latter was to ask Frau von Levetzov for her daughter's hand on Goethe's behalf—Goethe experienced such a storm of exaltation that he wrote the *Marienbad Elegy* at one sitting. It is one of his noblest works; its accents ring clear in the memory.

Wagner, passionately enamored of Mathilda Wesendonck, created *Tristan and Isolde*. At the age of sixty-four, he fell madly in love with Judith Gautier. Love exalting his inspiration, he produced *Parsifal*. "O warm, O gentle soul," he wrote Judith, "what inspiration I found within your arms!"

Dante's adoration of Beatrice enriched humanity with the *Divine Comedy*, which contains the best and most beautiful thoughts a genius ever conceived. Beholding Beatrice for the last time (she was seated upon a throne

in the third circle of the highest rank, making a crown for herself, "reflecting" the while "her own eternal brightness"), he bade her farewell (*Paradisio*, Canto XXXI):

*O Lady, in whom my hope hath vigor, and who
for my salvation didst endure to leave
in Hell thy footprints;*

*Of all things which I have seen I recognize
the grace and might, by thy power and
by thine excellence.*

*Thou hast drawn me from a slave to liberty
by all those paths, by all those methods
by which thou hadst the power so to do.*

Petrarch, too, found in the love of Laura his happiest inspiration, the exaltation of his genius, and the breath of his ecstatic inspiration. Does he not say as much, in Sonnet CLVIII, when he declares:

"Even as eternal life is but the contemplation of God, with nothing else desired or desirable, so but to behold thee is my only happiness in this frail and fleeting existence."

Many another poet or author comes to mind; at a given moment in their lives, love played a magnificent part in the potent stimulation of their creative genius.

* * *

Coffee is the least harmful of the excitants that make for brainwork. A dose of from fifteen to twenty grams per cup results in an acceleration of the pulse. The intellectual

faculties are excited, the imagination becomes livelier, the power of judgment is refined. But if the dose is increased to fifty grams per cup, the pleasurable sensation disappears; a marked acceleration occurs in the beat of the heart, cephalogy (headache) and vertigo ensue, the hands and feet grow numb, a sickish feeling comes over the body as a whole, and hot waves pass through it at regular intervals. A state closely akin to drunkenness is discernible.

Balzac cultivated a passion for coffee; he considered it indispensable for any effort of thought or creation. He describes its effects in a military report that would cause a general to turn green with envy:

"The coffee falls into your stomach. From that moment onward, everything springs into action. Ideas get under way like battalions of the Grande Armée on the battle-field, and the battle is engaged. Memories charge up, their banners flying; the light cavalry of comparisons develops a magnificent gallop; the artillery of logic marshals its train and its ordnance; sallies of wit rise like sharpshooters; figures begin to loom up, your paper is black with ink, for the struggle begins and ends in a torrent of black water, just as a battle begins with black powder."

Coffee was never absent from his table, he absorbed it incessantly, and often wrote uninterruptedly, day after day, twenty days in succession, from one in the morning to one in the afternoon. His mode of life was so unhealthy in every respect that it is difficult to determine what share

the excessive use of coffee played in his premature death. One fact remains certain: up to his death he retained the full power of his creative genius.

A complete antithesis of the ebullient Balzac, *Henri Poincaré*, a mathematician of austere habits, attributed one of his discoveries to the stimulus of coffee. "One evening," he writes, "quite exceptionally, I took black coffee. . . . I could not go to sleep; ideas crowded in upon me, I felt them as though clashing together, until they would mesh, as it were, in pairs, to form solid combinations. In the morning, I had established one class of Fuchsian functions, those deriving from the hyper-geometric series. I had now but to record the result, an operation of only a few hours."

* * *

Certain authors have resorted to alcohol in order to excite their intellectual faculties. First comes a profusion of ideas, together with flashes of wit, and eccentric sallies. These ideas are never conceived in moderation; all is disproportionate. The imagination is over-excited; reflection and judgment are diminished accordingly and, under strong dosage, all trace of intelligence disappears. Abuse of alcohol has proved a nefarious factor in the lives of not a few writers. Out of respect for their lamentably foundered genius, I shall not mention their names. Alcohol, in excess, degrades the human being.

* * *

Cocaine is, in weak doses, a great excitant. The stimulus of cannabis, or the hemp weed, first expresses itself by an

unwonted force of imagination and often a gay mood. The drugged person experiences a particular euphoria or sense of well-being, a pleasurable excitement. His need of food or sleep disappears, and he is able tirelessly to perform a considerable amount of physical and intellectual labor.

Of course, this result holds true only when the dose is absorbed in isolated instances. On the other hand, a much smaller dose—say, from two to three milligrams daily—taken successively for a few days, brings about an intensified cephalogy, with loss of sleep, fits of palpitation, and a fearsome terror of death. Few writers have employed this most dangerous of excitants, which, in greater doses, produces maniac fury and ruins both brain and heart.

* * *

Opium, on the other hand, and its derivative, morphine, were much used by men of letters up to a fairly recent period. Happily, the deceptive charms of this excitant lure fewer and fewer addicts among writers, since they have learned from others what fateful results this poison leads to.

In its initial stages, morphine creates a very definite intellectual excitement, with a heightening of energy and a sensation of delightful well-being. Repeated use, in small doses, causes first a period in which the psychical functions are all excited, and then, rather rapidly, a series of obsessive ideas, of delirious hallucinations and impulses. Man becomes a slave to the drug; an increase of

dosage becomes a necessity, and his intellectual faculties finally collapse.

Coleridge, a precocious genius, serves to illustrate the effect of opium upon literary production. In 1796, after the failure of a literary venture, he took opium, alleging, as an excuse, its soothing effect upon his rheumatic pains. For four or five years his literary output was prolific. During this period, he made continuous but moderate use of the drug. Then, however, his activity began to decline, growing ever more confused, until 1816. Throughout this second period, he produced practically nothing but a few undistinguished lectures. In 1817, he recovered lost ground, but only in the shape of a tragedy which failed. The rest, until his death in 1834, was silence.

It is unlikely that opium stimulated Coleridge's production significantly; his genius was manifest long before he turned to the terrible drug. The most we can assert is that opium, absorbed in small dosage over a period of a few years, did not lessen his intellectual activity. But the use of opium, with an inevitable increase of dosage, undeniably broke his health and annihilated his genius.

* * *

The use of hashish over-excites the intellectual functions. Ideas press ever and ever more speedily. Amid a perpetual fireworks, idea explodes upon idea with truly vertiginous rapidity. Thoughts come and go, pell-mell, crowding at each other's heels; the drugged person seeks

in vain to express all that he feels; language does not come quickly enough to express his thoughts. As in inebriation, thoughts and tongue become uncontrollable; all notion of time disappears; the brain grows ever more excited, and all power over action ceases.

A few Arabian writers have employed hashish habitually; in the Orient, inurement to it by heredity has probably dulled its effect. For Europeans, this poison proves too violent; it plays complete havoc with their ideas.

* * *

Artificial excitants, in the honeymoon of their use, may contribute a heightened brilliance to the pages of the author's daily stint; but at excessive cost, as Baudelaire proves all too tragically. A poet of genius, he sought not only the effects of alcohol, ether and hashish, but was among those to submit to the domination of opium. The author of *Flowers of Evil* spent the last years of his lamentable existence as a speechless invalid.

In conclusion, the result of all excitants is as follows: The poison acts first as a stimulus, adding nothing to the value of the person who uses it, increasing neither his creative power nor the beauty of his form; to the work, it contributes nothing that would otherwise have remained unexpressed or latent. It can offer no more than a slight, weak, fleeting blaze.

For genius is a gift innate, a quality which must manifest itself, a power which commands man; and inspiration

is a despotic force which man obeys with enthusiasm and joy. He must await its hour. In the long run, to speed it by unhealthy toxics is but to poison the brain centre that gives it birth, and to destroy genius, the noblest treasure man may possess upon earth.

CHAPTER XI

THE ROLE OF CHANCE IN THE CREATIVE
PROCESS

In discoveries, chance often serves as the point of departure. Astonishment at a new fact provokes a sort of mental excitement; thought is aroused, and reacts upon the mysterious faculties of the subconscious; the idea springs forth, and, in a flash, encompasses the remote consequences of an isolated fact. No fact, no event, is isolated in nature; always it forms part of a whole. Facts are linked, though the bonds connecting them are often too remote and too subtle for any but a genius to discover.

The crowd is mentally blind. To the image which strikes its eye, its mind reacts but feebly. The average man dwells upon thoughts circulated for all; he does not observe, he merely gazes. An unwonted fact may arouse a feeling in him, but rarely a fruitful thought. Only a superior mentality struck by a new fact is equal to deducing its remote consequences where others perceive nothing.

An apple falling from a tree generally suggests only the idea of going to pick it up; but to *Newton*, preoccupied as he was with astronomical problems, this feeling prompted a sudden question: "Why does the apple fall?" "And, if it falls because of Earth's attraction," he wondered, "why does not the moon, in turn, fall upon our

planet?" An idea so sublime could have germinated nowhere but in the brain of genius. Obsessed with this thought, Newton dropped various objects, each heavier than the last, from the roof of a house, then from a church steeple, bent on discovering whether the swiftness of the fall varied with weight and the distance from the ground. With exactly the same end in view, *Galileo*, before him, had dropped successively heavier weights from the Leaning Tower of Pisa; now Newton learned, by the same experiments, that attraction increases with weight, but diminishes with distance. The formula for the law of attraction was ascertained. Attraction was now known to be in direct ratio to weight, and in inverse ratio to the square of the distance.

Accordingly, the earth and the moon exert upon each other a reciprocal attraction, governed by the weight of their mass and the distance between them. Yet this could not have secured the equilibrium of their positions, Earth's attraction being far greater than that of the moon, which is much smaller than our planet. Before arriving at a comprehensive view, Newton had therefore to discover the effect of the sun and the influence of the planets gravitating, just as the earth does, around the sun. He had further to determine their weight, and their respective distances from one another. Hypotheses and calculations covering a period of seventeen years finally established the degrees of attraction of all these celestial bodies in a direct and in a tangential sense. The mathematical cause

of equilibrium was discovered; the laws of universal attraction, of celestial mechanics, were definitely fixed. Setting them forth in his *Mathematical Principles of Natural Philosophy*, Newton wrote:

“This secret and mysterious virtue pervades the depths of nature and establishes a mutual dependence and a kind of unbreakable bond between all elements of this vast universe. Each part reacts upon the whole, and the smallest atom attracts all others, without distinction, preference or choice. All the phenomena of the world’s system thus find themselves linked in one admirable whole, and the physical theory of the universe is reduced to a single principle.”

The grandeur of Newton’s work and the immensity of his thought illustrate to what heights the human spirit can soar and what marvelous powers the human brain possesses.

Ninety-three million miles separate the sun from the famous apple which had fallen so opportunely; immense distances separate the earth from the various planets. But Newton, thanks to his genius, brought them close to us, and we can now embrace them in a sweep of the mind. . . .

Twice in his life, chance played an important part in *Darwin’s* labors. The starting-point of his entire contribution is to be found in his astonishment, during a journey to South America, upon unearthing the fossilized remains of a gigantic armadillo that resembled the species extant.

A sudden thought crossed his mind, the thought of the possible relationship between extinct animals and those living today. From that moment onward, his entire attention was turned to this matter. He sought for any fact which might enlighten him upon this subject.

Continuing his journey, he was deeply impressed by three classes of phenomena: first, the manner in which kindred species succeed and replace one another as the traveller proceeds southward; second, the close relationship between species native to islands near the mainland, and species on the mainland itself; finally, the narrow bonds which unite toothless mammals and living rodents to the extinct species of the same families. From all this, he concluded that these related species might derive from the same source and descend from some common ancestor. Nevertheless, for some years, *Darwin* could not understand how the supposed variations could have been produced. When he undertook the systematic study of domestic animals, he learned that the most important modifying influence lay in the selection of strains by breeders who used them for the reproduction of better specimens. Still, he did not perceive how a selection similar to that of breeders was feasible in the case of wild animals.

A chance, pastime reading of Malthus' *Principles of Population* finally brought him the desired answer. *Malthus*, the English economist, laid down the proposition that population increases in geometrical, while food in-

creases only in arithmetical progression; as a result, an enormous number of individuals are eliminated in the struggle for life. Now Darwin was already well prepared by his prolonged observation of animals to appreciate the struggle for life, and his geological researches had taught him the enormous span of time elapsed. The reading of Malthus' book brought him the ray of light which he needed in order to formulate his principle of natural selection. He based it on the variation of the species, in their domestic state; pigeons furnished him with the best example, since they all descend from the Rock or Bizet pigeon. Next, he studied variations in the wild state, in which the hereditary transmittal of increasingly marked individual differences finally formed separate species. He then included the struggle between members of distinct species and of the same species, instancing the English bee, which, when imported into Australia, exterminated the stingless native variety.

Further, he studied the struggle against physical conditions of life: the cold of winter, insufficient nourishment, extermination by stronger enemies; the preservation of variations favorable to the organism, and the elimination of noxious deviations, appeared to him to be the cause of that natural selection which tends to perfect every living being in relation to his conditions of life.

Lastly, he considered sexual selection. Males best endowed with strength, speed and song are those who reproduce; the others are killed or eliminated, as, for in-

stance, among bulls or stags. With birds it is the splendor of their plumage, or the beauty of their song that ensures the reproduction of superior beings, as I showed in my book *Love and Thought in Animals and Men*. Nightingales indulge in vocal exercises in the presence of the females. The blackbirds of Guinea, and birds of paradise, too, are wont to foregather; the males, each in turn, spread their magnificent plumage before the females, who attend this tourney both as onlookers and as judges, and finally select the mate who has pleased them most.

From a thousand similar observations, Darwin concluded that existing species issued progressively from other simpler species by means of a lengthy evolution through geological ages. This theory of the evolution of species aroused passionate discussion and opened new horizons upon the descent not only of animals, but of man, whose origin in the limbo of time would seem to go back to an ancestor common to himself and to the ape.

I myself was favored by a chance circumstance which proved to be the starting-point of my work on rejuvenation.

One day during my stay in Cairo in 1909, the Khedive's physician, a highly cultured Egyptian, told me that the chief eunuch of the palace had just died. I answered that this did not surprise me; I had met him several times, and noticed that he was very old, at least eighty, I thought. To which my friend countered that I was completely

mistaken. The eunuch was fifty-two, or at most fifty-three; his age was well known to within a year or so, since he had been bought by the Khedive's father some months after castration in a Coptic convent in the Sudan. Incidentally, it was the monks who, according to custom, performed the operation; it was done without an anaesthetic, the hemorrhage being arrested by pouring boiling oil on the wound. The late eunuch, moreover, was the only survivor of four Negro boys who had undergone this horrible mutilation at the same time. He might have been about seven or eight at the time he was brought to Cairo.

His death at the age of about fifty-two in nowise astonished the Mohammedan doctor. Suddenly a thought sprang to my mind; I realized that the premature aging of eunuchs, and their death at a period when normal man still retains his vigor unimpaired, must be connected with the removal of their genital glands. Were not these glands therefore the source of our vital energy? Proceeding from this idea, I became interested in eunuchs, a class of men who previously had left me quite indifferent. I examined several of them, questioned them, and recognized the disastrous effects of castration upon man. Deprived of their genital glands from childhood, eunuchs remain weakly, flabby-skinned, and most of them fat. All physical effort comes with difficulty; they can do little more strenuous than play the leisurely part of guardian to the seraglio. Their physical debility seems to affect all their organs, which function at a slackened pace. Their mental debility

is equally marked; their memory is feeble, their intelligence lazy. They grow old prematurely. At the age of forty or fifty, they already bear around the pupils the senile milky circle which normal men acquire at three-score years and ten, or later. Eunuchs rarely reach an advanced age.

A man, I argued, may at birth possess all the organs of normal man; deprive him later of but one organ, and its loss makes him a victim of debility, of the infirmities of age, of a physical and mental decay. Have not these glands a dual function? They produce the elements necessary to fecundation, but they also secrete a liquid, a hormone directly reabsorbed by the blood to sustain the energy of the body. Castration, then, not only deprives man of the ability to create new lives, it also robs him of the source of energy of his own life. The relation of cause and effect, between the general depression of the organism on the one hand, and the removal of the genital glands and of their internal secretion on the other, admitted no further doubt.

Ideas became coordinated, the hypothesis was taking shape. In the normal man, is not age marked by physical enfeeblement, increasingly evident as he grows older, in lack of memory, mental sluggishness and the tendency to repose? Meanwhile, do not the genital functions decrease and actually cease in very old men? With advancing age, man, year by year, approaches the state of the eunuch. He is not castrated by the cruel hand of his fellow, but by

a nature no less cruel. As genital activity gradually disappears, as the internal secretion of these glands of youthfulness are impaired by age, so vital energy is lessened. The aged can boast no such resistance as the robust man musters against unfavorable conditions like humidity, cold and sickness. Old age is the antechamber of death.

The case of the eunuch, prematurely senile and dead before his time, revealed nature's secret to me; I knew now what part the genital glands played as activating agents of vigor and energy for body and mind. The idea of re-equipping the organism with young glands, when old men's are no longer capable of functioning, naturally presented itself to my mind as the logical deduction of what I had just observed.

I did not pretend to equal nature by imitating the process she employs to conserve body energy. The conditions are not the same. It is at birth, in the very morning of life, when the body is young, growing and developing, that nature offers man his organs; whilst I, on the contrary, set myself the task of introducing young glands, borrowed elsewhere, into an old body, whose every organ functioned at a slackened pace. Glands grafted upon a human being in his declining years could not be expected to function as his initial glands had, for sixty or seventy years. Any such claim would be preposterous; any such achievement, futile in any case for an old man. A progressive perfectioning in technique, a growing knowledge of the blood-groups of monkeys, in order to match them to

those of man, and the grafting of thyroid and pituitary glands simultaneously with genital glands, now ensure the functioning of the grafted glands for six or seven years, instead of for three or four, the limit of my achievement in the beginning. During this period, man recovers all the physical and mental aptitudes which he possessed as an adult in the prime of life and which age had destroyed or enfeebled.

Further, this grafting upon thousands of individuals has shown that, after activity of the transplanted glands has ceased, the individual finds himself exactly as he was before the operation. He is not, as might be expected, in the condition of a man six years older than he was before the operation. These six or seven years are a gain, since they were subtracted from his normal old age. What is more, the operation of grafting may be repeated.

Thus, thanks to chance, science has been given a process of rejuvenation which assures an old man the return of the vigor and energy which he possessed twenty years before; this, for an appreciable number of years, at a time when every year counts. . . .

Thomas Edison, that genius who dazzled the world with his phenomenal inventions (to the eternal glory of his native United States), also owes to chance one of his greatest discoveries, that of electric light.

The heavens preceded the earth in the use of electric light; on stormy nights, lightning illumines the atmos-

phere. But to harness such lightning to the use of man was obviously a delicate task. This formidable electrical force had first to be divided and detailed, miniature flashes of lightning had then to be produced.

Scientists, finding it all an impossible dream, discouraged any enterprise in this direction. But Edison was no mere scientist; he was a great genius. He described electric current in his own way:

"Imagine," he said, "that you have a terrier whose head is in London and whose tail is in Edinburgh. Pinch his tail in Edinburgh, and he will bark in London. That is all I can tell you. I don't know what happens in the electric wire any more than in the terrier."

With such plain, sane, homespun ideas and with such genius, Edison was not the man to abandon his research because the scientists declared them impossible.

It was already known that a current between two not distant conductors produces a spark. Unfortunately, after having thrown off a bright light or spark, the metal wires immediately melted. The problem lay in finding a thin but very resistant filament, able to receive an electric current without burning up. Eight months of research, from September 1878 to April 1879, convinced Edison that the problem was insoluble. He abandoned his fruitless labor to concentrate upon other, less forbidding inventions.

Now, on October 18, 1879, while sitting alone in his laboratory, his hand on the table encountered a small piece of tarred, compressed lamp-black. Absorbed in his

reflections, he was unconsciously kneading the lamp-black, stretching it this way and that. Suddenly he noticed that he was holding a thin, black filament, and, like lightning, the thought flashed through his mind that this carbon filament might serve, through its resistance to the electric current, to make light endure.

He proceeded to carbonize all sorts of substances, from among which he finally chose cotton. After numerous attempts, he succeeded in introducing a segment of carbonized cotton into a bulb. A vacuum was formed, and the filament was charged with electricity. The light burned for forty hours in the little glass globe.

Here was a great discovery; the electric lamp invented that day in Orange, New Jersey, has spread, like a luminous ray, to lighten the darkest corners of the world. Night and its shadows were forever conquered, thanks to the genius of Thomas Edison.

Chance also aided *Pasteur*, as it always aids those capable of seeing and piercing the spirit of things by an intuition of the deeper meaning of facts. We shall cite one example only, but a most characteristic one:

One day, Pasteur was walking with his friend, Maunoury, over a field on a farm at St. Germain. His attention was suddenly attracted by one part of the field because of the different color of its earth. Maunoury explained that they had buried some sheep there the year before; the

beasts had died of anthrax, a very contagious disease, which turns the blood of afflicted animals black.

Pasteur, ever the careful observer, noticed a number of little clods of earth on the ground, such as earthworms heap up as they dig their way to the surface. It immediately struck him that the worms, in their continuous journeyings, brought to the surface an earth rich in the humus surrounding the corpses, and, with it, the anthrax spores which it contained. If, therefore, animals browsed on this ground, they would be infected by the virulent microbes, and later die of the disease.

Thus, through the observation of a fact which had previously attracted no attention, Pasteur discovered how this disease was spread. For years, people knew that there were "accursed fields" visited by a malediction of sorts, but neither veterinaries nor cattle breeders suspected that animals, dead of anthrax and buried in the ground, could have been the cause. They may have seen the clods of earth, but these conveyed nothing to their minds, least of all the suggestion of a possible relationship between these small bits of earth, the underground activity of the worm, and the corpses of the animals buried there.

The stroll Pasteur took that day has saved thousands of animals. After the memorable walk, he became interested in the question and completed his work by inventing the anti-anthrax vaccine, which cures both animals and men stricken with this dread disease.

Besides Pasteur's, many other examples of accidental discoveries come to mind. The fortuitous observation of the lamp swinging in the middle of the Cathedral of Pisa permitted *Galileo* to perceive that its oscillations were isochronic, or strictly equal in all its movements. This novel fact proved important for science, since its discovery was to lead to knowledge of the laws of the pendulum, to the latter's application to the clock, and to the whole vast progress in mechanics, astronomy and physics made possible by a more accurate measurement of time.

The discovery of modern photography is in part also due to chance. Some progress had already been made on heliographic pictures by J. Nicéphore de Niepce, working in collaboration with *Louis Jacques M. Daguerre*. But Niepce died in 1833, before the goal had been reached. Daguerre, continuing the attempt, was conducting experiments with iodized silver plates which had to be exposed to the light for a considerable time. One day, he forgot a plate he had relegated to a cupboard because its exposure had been too brief to permit of the picture's development. When he found it again, to his great surprise, the process of development had been completed. Thinking this was due to some one of the objects in the cupboard, he removed them one by one, leaving a fresh plate with an impression on it each time. The cupboard seemed empty, yet a picture always appeared. Daguerre was about to cry "witch-craft", when he noticed a capsule,

filled with mercury, lying in a corner. Now, since mercury is a metal which emits vapors at ordinary temperature, Daguerre presumed that the emanations of this substance might have developed the pictures. To make sure, he took a plate which he exposed for a short time, and on which no traces were yet visible; he then exposed it to the mercury's emanations, whereupon to his amazement, an image appeared. Thus photography, the child of chance, set forth upon the path of progress.

It was luck, too, which enabled the eminent German physician, *Roentgen*, to discover X-rays, which permit man not only to photograph the internal organs, but to detect frauds, and to identify works of art, manuscripts and the like. Even as Daguerre, Roentgen had forgotten some old photographic plates, without impressions, in a drawer. Electric discharges between two electrodes, which he was setting forth in the course of some laboratory experiments, made an impression on the plates, a fact he noticed only upon taking them out of the drawer. It proved to him that the rays termed cathode, generated by electric discharges in a vacuum between two electrodes, were capable of making pictures of bodies placed between them. Few discoveries have proved more wonderful in their contribution to the immense progress of medicine.

Our knowledge of the composition of celestial bodies was also a discovery of chance. We owe it to *Vossius*, a

German savant of the seventeenth century, who observed that a prism decomposes light. Now, every ignited metal causes a particular ray to appear in the spectrum of the sun and of the stars. Their composition no longer holds any secrets for us; the millions of miles that separate them from us have not prevented us from minutely examining all the metals and gases which compose them.

Chance, too, governed the discovery of new planets such as Uranus and the very small so-called telescopic planets, and the invention of those instruments indispensable to the advancement of astronomy. The spy-glass, for example, was casually invented by children playing with glass in an optician's workshop. Christian Huygens, the celebrated Dutch astronomer, said that without this help of fortuitous circumstances, the invention of the telescope would have required a superhuman genius. Today, the telescope permits us to travel across the skies and visit all the stars in perfect safety.

Chance, too, taught man how certain so-called undulating or Mediterranean fevers, of frequent occurrence in the Mediterranean basin, are propagated. A commission of British scientists was established on the island of Malta to seek the hiding place of the virus responsible for this disease. Soil, well-water, even sea-water had in turn been tested in vain. The commission fortunately numbered among its members a Maltese physician. The latter, for some personal experiments of his own, which had nothing

to do with the commission's work, needed animals of a certain size. Goats are plentiful on the island, so he secured five milch-goats. Before proceeding with his experiments, he examined the blood of these goats and to his great surprise found it contained the microbe of undulating fever. The microbe was found not only in the blood, but also in great quantities in the milk. And it is precisely through goat-milk, a favorite food of the natives, that man contracts this fever.

I should like to conclude this chapter with the account of a discovery made by my eminent colleague at the Collège de France, the late Dr. Nicole, while he was chief physician at the Hospital of Tunis.

Typhus is a terrible disease, one which decimates poor populations, and often ravages overcrowded prison-camps. In Tunisia, it was virtually endemic. Until Nicole's discovery, the method of its spread was unknown, and it created untold havoc. Here is the description he himself gave of his discovery:

"One day, a day like any other, doubtless obsessed by the riddle of typhus contagion—I am sure I was not consciously thinking of it—I was about to enter the hospital. Suddenly I was stopped by a human body lying in my path. Often the wretched natives would stagger up to the hospital, but, mad with delirium, would fall in a heap at its very portals. As usual, I strode over the prostrate form. At that instant a great light flashed over me. One moment after, as I entered the hospital, I held the answer to the

problem. I *knew* that no other explanation was possible. That prostrate body on the doorstep had revealed to me the secret of typhus contagion. Here was a disease, virulent throughout the land, virulent in the city too, yet harmless within the walls of the hospital. Very well, then, what happened in the receiving-ward? The patient was relieved of his clothes and his linen, he was washed and shaved. Something foreign to him, which he carried on his person, his linen or his skin, caused the contagion. It could only be the louse. It was. What I had not dreamed of the day before, what no one had noticed since the dawn of history—for typhus goes back to the most remote periods of humanity—the indisputable, immediately fruitful solution of the method of transmission had just been revealed to me.”

Humanity that day was enriched by a new benefaction brought to it by genius. Chance, as always, merely awakened a luminous, fecund thought in an intuitive mind.

CHAPTER XII

THE FORERUNNERS: GENIUS IN THE PAST

In dim antiquity, we find geniuses whose thought equals that of modern geniuses. These remote geniuses conceived the same high moral and religious principles as the founders of more recent religions. *Moses*, with his laws of social life, forbidding murder, theft and so forth, and *Buddha*, with his injunctions to men to love one another, may rightly be considered as forerunners. And are not Socrates, Plato, Aeschylus, Sophocles and the rest, those philosophers and writers who voiced the Greek genius with unparalleled brilliance for one century (530–430 B. C.), forerunners of the philosophers and writers of the present day? Is not Phidias, who represents the same period, the forerunner of the most celebrated sculptors?

By the same token, the noblest scientific conceptions of the last three or four centuries germinated in the minds of geniuses who drew breath some thousands of years before our time. Ideas exist in the human mind that answer laws of nature still unknown. A genius bears the formulas of these hidden laws which are unperceived by anyone else; he discovers them in the mute depths of matter. The high antiquity of the most general ideas of contemporary science are readily explained, if we remember that those

principles and those ideas correspond to the deep, urgent needs of human thought. It is not in grandiose conceptions that those remote periods differ from ours, but rather in the means of proving or of applying them.

The theory of Earth's movement around the sun goes back to the Pythagoreans and to *Aristarchus of Samos*, who lived about 280 B. C. Yet, until the fifteenth century produced *Copernicus*, a Catholic priest, mathematician and astronomer (1473–1543), man clung doggedly to the belief that the sun revolves about Earth, centre of the universe. This erroneous conception, uttered by *Ptolemy*, an Alexandrian astronomer, in the first century of our era, received the support of the clergy because it tallied with Biblical teaching. Do we not find in *Joshua*, X, 12: "Then spake Joshua to the Lord in the day when the Lord delivered up the Amorites before the children of Israel, and he said in the sight of Israel: Sun, stand thou still upon Gideon; and thou, Moon, in the valley of Ajalon." And further (13): "And the sun stood still, and the moon stayed, until the people had avenged themselves upon their enemies."

Again, is it not written in the *Book of Judges*: "So the sun stood still in the midst of heaven, and hasted not to go down about a whole day." Finally, in *Ecclesiastes*, I, 4–5: "One generation passeth away and another generation cometh, but the Earth abideth forever. The sun also ariseth and the sun goeth down, and hasteth to his place where he arose."

Could anyone doubt the movement of the sun around the earth, when it was so clearly indicated in Holy Writ? The treatise on *The Revolutions of Celestial Bodies*, published by Copernicus in 1537, caused acute discomfort within the Roman Catholic Church, and was condemned, on March 5, 1616, by the Sacred Congregation of the Index, founded by Pope Pius V in 1570. The text of this condemnation follows:

“The Pythagorean doctrine which, falsely and contrary to Holy Scripture, admits the mobility of the earth and the immobility of the sun, as taught by Nicholas Copernicus, in *The Revolutions of Celestial Bodies*, and by Diego Zunica in his *Book of Job*, tends to be divulged and propagated. Consequently, in order to check the future dissemination of this opinion subversive to the Catholic truth, the Sacred Congregation of the Index advises that the above-mentioned works of Copernicus and of Zunica be suspended until corrected.”

It was only on August 16, 1820, that the Inquisition permitted the affirmation of Earth's movement; later, the decree approved by Pope Pius VII, on September 17, 1822, granted permission to print and publish works dealing with the mobility of the earth and the immobility of the sun.

Copernicus was not content to affirm the movement of Earth and of the planets around the sun, as taught by the Pythagoreans and Aristarchus of Samos; he went so far as to prove it and to plot our solar system. “Venus, Earth,

Jupiter, Mars and Saturn turn circularly around the sun," he declared. "And beyond, stretches the motionless sphere of the fixed stars."

Copernicus' doctrine was necessarily imperfect for lack of instruments to observe celestial bodies; but for all that, it initiated a scientific revolution which has not yet ceased. Is not this priest of genius rightfully one of Newton's forerunners?

A man even more deserving of so glorious a title is *Johann Kepler* (1571–1630), who formulated the fundamental principles of astronomy, as astronomers have employed them since. He established the mathematical relation between the duration of planetary revolutions and the range of their orbits. This law constitutes the major portion of his *Harmony of the Universe*, published at Linz in 1619, about which he writes: "Now the die is cast, and I write this book; it matters but little whether it be read by the present age or by posterity; it may await its reader for a hundred years, if God waited six thousand years before He found a contemplator of His works."

Kepler could not pursue his studies at Gratz. He had to seek refuge at Prague, after the Archduke Charles was succeeded by his son Ferdinand, who appointed the Holy Virgin generalissimo of his troops, and swore to extirpate heresy throughout his dominions.

The famous astronomer, *Galileo* (1565–1642), was an even closer forerunner of Newton.

Thus it was that four scientists, *Aristarchus*, a Greek,

Copernicus, a Polish priest, *Kepler*, a German, and *Galileo*, an Italian, paved the way for the arrival of *Newton*, an Englishman, who was able synthetically to combine their scattered works, and genius-like, to discover the law of universal attraction, which no precursor had foreseen or even dreamed of. Alas! routine, intolerance and human blindness belong to every age of history. Contemporary scholars, and the most illustrious among them at that, persecuted *Newton*, brutally attacked him and denied his discovery.

To turn from astronomy to the natural sciences, and from *Newton* to *Darwin*, we observe that six hundred years before our era, *Anaximander* conceived the transformation of species. He taught that the earliest animal organisms sprang from the waters of the sea, and, through gradual modifications, evolved into man. Here was a forerunner of *Darwin*! Another was *Empedocles*, who over two thousand years ago championed the idea of natural selection, which *Darwin* at first based upon an artificial, man-made selection producing new races daily, and only later upon a selection made by nature with the help of time.

The English and French naturalists, *Wallace* and *Lamarck* were contemporaries, rather than forerunners of *Darwin*. As for his detractors, I could not possibly begin to enumerate them. *Darwin's* conception upset men's minds, aroused fierce discussion, and provoked incredulity. It has continued down to this day. It is still vio-

lently attacked by some, and passionately defended by others.

The immense progress in modern mechanics, the invention of the steam engine, the explosion engine, the railway, the steamboat, the telephone and the airplane were all imagined by men of genius at times when nothing pointed to their possibility. The man of genius is a visionary. He owns the secret of the universe. All possibilities are reflected in him.

The idea of a motor set off by heat may be found in the writings of the Greek philosopher, *Heraclitus*, more than two thousand years before our era. *Roger Bacon*, a Franciscan monk of Oxford, who lived in the thirteenth century, foresaw automobiles, steamships and airplanes. In a work of his, we read:

“There will be navigating machines which will not hold oarsmen, so that great ships, adapted to rivers or to the ocean, guided by a single man, will be able to go forward at a greater speed than if they were filled with men. By the same token, man will construct carriages capable of movement without the help of any beast of draught, much like the vehicles equipped with fire, upon which, we believe, the ancients fought. Flying machines are also within the realm of possibility, so much so that man will be able to sit in the middle of them and move a lever, by means of which artificial wings will beat the air, like a bird in full flight.”

Leonardo da Vinci (1452–1519) went even further.

In the works of this man of genius, painter, sculptor, mathematician, architect and naturalist, we find even the first attempts to realize airplane and submarine. He left two sketches of great interest. The first presents a helicopter, together with a description suggesting that he made small helicopters, worked by springs, fly aloft. The second illustrates a parachute in the form of a pyramid; it, too, is accompanied by a description. As for the submarine, da Vinci not only conceived its plan, he even foresaw its abominable use. "If I do not divulge this engine, it is because I dread the evil that is in men. They would use it basely in the depths of the seas, ripping up ships and sinking their crews. I here present only such procedures as offer no danger, since the piece of pipe, through which those undersea breathe, emerges clearly over the surface of the waters."

Here was a human being with a well-nigh miraculous vision of reality; but if mind was ready for the most unheard-of appliances, science was not. Applied science was still very elementary at the time; it did not allow the practical execution of what mind had imagined. Ideas born too early in the minds of certain genius-like forerunners do not pass beyond intuitions or projects; the science of the day is too poor to enable them to take practical shape.

It was only in the eighteenth century that the Abbé de Hautefeuille built the first motor. He caused gunpowder to explode in the base of a pump; but such machines

proved so impractical that Denis Papin substituted steam for powder, thus steering mechanics into the path it has followed since. Because of its drawbacks, the idea of an explosion motor lapsed into oblivion for two hundred years, until, one day in 1860, the French inventor, Étienne Lenoir was inspired to replace gunpowder by a mixture of explosive gases. In the fifteenth century, the very existence of gases had not been dreamed of.

Telegraphy too was conceived in the sixteenth century. Before 1600, there had been speculation about the possibility of corresponding at a distance by means of magnetism and electricity. In a work published in 1524, Père Leureuchon, a Jesuit, described an imaginary apparatus, which, he said, allowed people to speak to one another from afar. His project presented magnets which, by their corresponding motions, would make needles work over a frame, bearing the twenty-four letters of the alphabet. The figure accompanying the text is practically that of the Bréguet telegraph. Thus *Père Leureuchon* blazed the trail for *Morse*, the American, for *Weatston*, the Englishman, and for *Steineul*, the German, all of whom contributed to give us modern telegraphy.

The mind knows no limit, intelligence takes flight, but matter is heavy; we must learn to break down resistance and to bend it to our will. Electricity, that impalpable fluid unknown for thousands of years, had to be discovered. So had the Hertzian waves which allow us to transmit thought and speech across space. Timeliness is

imperative; any idea voiced prematurely is doomed to failure, or to worse than failure—neglect. Long after, when human intelligence has rediscovered it, people grow suddenly aware of its existence and enunciation in the past. Often, too, no one remembers the unknown, genius-like forerunner; scholars of history will be needed to retrace his thought across the oblivious centuries. A certain temper of mind among men capable of understanding a discovery is required before the latter may spread and bear fruit. This is a sociological rather than a scientific consideration; it might well be called the social moment. In reality, any discovery or invention is closely bound to some previous discovery or invention.

A rare exception to this rule is the creation of modern chemistry by a single man, *Antoine Laurent Lavoisier* (1743–1794). Worthy of note, and to the glory of human genius, Lavoisier was no chemist but a commissary of the Treasury, much as the creator of modern medicine was not a physician but a chemist, Louis Pasteur. Their genius supplemented their ignorance; each created a science without being destined to do so. Lavoisier uncovered a host of very simple facts which thousands of observers before him had failed to notice, though all had had as good an opportunity to notice them. He tackled and understood everything. At a time when water and air were considered indissoluble, he analyzed water, proving it to be composed of oxygen and hydrogen; and he analyzed air, proving it to be seventy-one parts nitrogen and

nineteen oxygen. He determined fermentation and demonstrated the mechanism whereby living beings produce heat. Discovery followed upon discovery, so much so that in its broad outlines modern chemistry may be said to spring from Lavoisier's powerful brain. What most aroused the indignation of the wiseacre scholars was Lavoisier's discovery that air was no simple gas, but rather composed of nitrogen and oxygen. What! An amateur, a dabbler, a financier and Treasury collector, dared to question the time-hallowed dogma of the irresolvable nature of air! In Berlin, Lavoisier was burned in effigy, as a heretic of science.

Truly, laymen are no more tolerant than churchmen, if their dogmas are assailed; yet these dogmas are in no way sacred. Fundamentally, neither religion nor science are responsible for the persecution of scientists; their persecution is born of our passions, of our villainous human passions, and of routine. These passions cost Lavoisier his life. His head rolled under the guillotine during the great revolutionary turmoil in France. The services he had done science counted for little at the time; his crime was that he had served the ancient régime, an abhorred government. As he pronounced the death sentence, Coffinhal, President of the Jury, uttered the unhappily celebrated words: "The Republic needs no scientists; justice must take its course."

Lavoisier may rightly be considered the forerunner, not of this and that chemist, but of all modern chemistry.

Yet, aside from him, all discoveries mark the crowning of works laboriously performed throughout the centuries, the results accumulated by a multitude of relatively obscure workers. Once the progress of universal science has sufficiently prepared the mind of mankind, once an idea floats in the air, borne from land to land, ready to impregnate any genius who is prepared to accept and develop it, then at last the discovery is made. This explains how several inventions were simultaneously announced, like telegraphy, mentioned previously, the telephone by *Alexander Graham Bell* and *Elisha Gray*, the gramophone by *Thomas Edison* and *Charles Cros*, the theory of transformation by *Charles Darwin*, *Johann Wolfgang von Goethe*, *Wallace* (*Lord Alfred Russell*), *Jean Baptiste Lamarck* and *Geoffroy St. Hilaire*, photography by *Louis Jacques Daguerre* and *W. H. Fox Talbot*, and so forth.

Even in the case of undeniable geniuses, of the greatest promoters of scientific and artistic progress, their discoveries may be credited to either happy strokes of luck or the age-long collaboration of generations. Even *Louis Pasteur*, whose discoveries were prodigious, has several forerunners. His glory lay, first, in synthesizing all the scattered works and facts that had passed unnoticed and misunderstood; next, in bringing forth the truth comprehensively; next, in proving it by demonstration; and finally, in directing the evolution of science along a road which offered humanity the greatest discovery ever made in the history of medicine.

No man stricken with an infectious disease or subjected to surgical operation but owes Pasteur his life. Before Pasteur, no one knew that illness was due to microbes; their very existence was unsuspected; since physicians were ignorant of what really caused a disease, any severe attack spelled death for the patient. Operations, before Pasteur, were undertaken by surgeons who neither washed their hands nor sterilized their instruments. No matter how slight the operation, the mortality rate ran from seventy to ninety per cent, due to infection of the wound. Patients did not die of the illness, they were killed by surgeons who, ignorant of microbes, infected the wound with their dirty hands and the dirty instruments they used indifferently to lance an abscess, to amputate an arm or leg, and to open the abdomen. Considering all the minute preparations and the stringent antiseptics of modern surgeons, it is truly horrible to recall the stubborn resistance Pasteur encountered from the surgeons of his day. Did not one of them dismiss Pasteur's advice of antiseptics with the stupid argument: "Of what use is it, for instance, to sterilize a needle in order to make an injection? One thing or the other is true: either the microbes lie all along the needle, in which case the skin is too taut to offer them admittance; or they lie on the point of the needle, in which case they will fall off, or, failing, will be transfixed as the needle pierces the skin."

To recall his remote forerunners is not to rob this great genius of an iota of glory. Paracelsus, von Helmont,

Becher and Boyle had noted the relation between fermentation and illness; Davaine and Reyer, twenty years before Pasteur, had discovered the bacillus of anthrax and vaccination against disease, and, before them, Jenner had discovered the vaccination against smallpox which we still practise today.

Yet, though we praise these forerunners, they contributed no more than isolated facts and suggestions, which they could neither develop nor incorporate in a general system. They lacked genius; Pasteur possessed supreme genius, and to him goes the eternal gratitude of humanity.

Enemies, envy and jealousy gnawing at their hearts, ignorance and routine stifling their understanding, attacked him fiercely and slandered him viciously; nevertheless, he knew the exceptional happiness of finally achieving glory during his lifetime. Usually, mankind waits for a genius to die before doing him justice. When he is at last powerless to stand in anyone's way, his fellows cover his grave with flowers.

William Harvey, who discovered the circulation of the blood (1578–1657), had few forerunners. Physicians before him would bleed their patients copiously, so copiously indeed, that the latter would die, to the great surprise of the former, who had expected to cure them. While bleeding their unhappy clients, they were utterly unaware of the circulation of the blood! To be sure, they

opened the veins, but according to ancient and venerable rule, these alone were supposed to hold blood, the arteries only air. No doubt could rise on that score, since it derived from the teachings of the mightiest and most sacrosanct authority, Aristotle. So almighty was his name in the eyes of professors of medicine that they tipped their caps whenever they uttered his name during a lecture. The only sane but somewhat limited conception of the circulation of the blood was advanced by the Italian physicians, Cisalpine, Colombo and Fabris d'Acquapendente, who may be considered Harvey's immediate precursors. Incidentally, the latter, according to tradition, was first inspired with his theory of arterial circulation upon seeing red arterial blood flow from the wound of a doe during a royal hunt. This beast, in Harvey's case, played the same part as the falling apple in Newton's.

For my part, I, too, am unable to take exclusive credit for the discovery of human grafting; grafting must truly have been one of humanity's dreams in the remotest ages. What a noble dream it is, too, to replace an organ destroyed by accident or sickness, to recover the integrity of one's body! The operation of grafting was first performed in the Far East some three thousand years ago.

Curiously enough, it was robbers and not honest men who were to profit by it first. In those distant times, the robbers needed it more urgently, since the custom was not to clap them into prison, but to cut off their noses. Now, many of these robbers, in losing their noses, did not

lose the treasure they had stolen. They were thus in a position to reward skilful surgeons who could repair their all-too-obvious deformities. This is exactly what happened. In a sacred book of India, the *Ahurveda Sarustra* (800 B. C.), we read that the Brahmin priests had long been offering this service to robbers. If circumstances permitted recovery of the nose immediately after amputation, it was reaffixed, and assumed its normal appearance. Apparently, this skilful operation was usually crowned with success, and the thieves could reassume the appearance of honest men. These good Brahmins went even further. Where the precious nasal appendage could not be recovered or had been ruined by a clumsy executioner, these holy surgeons carved a piece of skin out of the robber's forehead or his back, and used it to fashion a new nose.

I had another distant forerunner in the person of an Italian of the sixteenth century, Molinelli, who did the same service for a Venetian gentleman, deprived of his nose by the hangman for some crime or other. Immediately after amputation, the nose was brought back to Molinelli in a warm loaf of bread; the surgeon succeeded in restoring it exactly to its lawful owner.

In Europe, human grafting did not come into practice until the celebrated British surgeon, *Joseph Lister*, inspired by Pasteur's work, instituted antiseptis, and surgeons respected the necessity of sterilizing instruments and objects used for operations. Thenceforth, surgery

made giant strides, and the art of grafting was developed to the highest degree. Scientists like Olier, Reverdin, Kocher and Kutner made invaluable contributions. The grafting of skin has become an habitual procedure; and the grafting of bones was of great service during the World War.

In the case of bones, the problem was simple. From primitive times, we have retained a bone which was helpful to us in climbing trees, to seek refuge against the attacks of beasts, and shelter for our night's sleep. With the march of time, we forsook caves for huts and, finally, for houses. The bone designed to aid us in climbing trees has become useless, or at any rate it gives us help we no longer need. This bone, called the peroneus, is in the leg, close to the shin-bone; and, as the latter requires no support from its neighbor, the peroneus may be removed without damage to the leg in either standing or walking. Running beasts, such as the horse and the camel, whose ancestors never climbed trees, possess the peroneus only in its most rudimentary state.

When it is a question of repairing a fracture of a bone in the arm or leg, it is easy to borrow from the patient's own person a part of his peroneus and to fit it between the two ends of the broken bone, after the latter has been scraped. The World War furnished surgeons with countless opportunities to practise this form of grafting. Our terrible modern engines not only break bones, they also

tear away great fragments, leaving gaps which can be spanned only by grafting.

The French government appointed me to take charge of this work. In 1915, it founded a special hospital for the purpose, the Hospital of Bone Grafting, Auxiliary Hospital No. 197, Paris. But already at that time, in order to spare a wounded body any additional pain, I had begun to resort to the bones of monkeys. The first wounded man to profit thereby is indebted to Raymond Poincaré, then President of the Republic, who personally arranged for my hospital to use the only chimpanzee owned by the Paris zoo. Later, I received other monkeys from the French colonies, and I was able to rehabilitate a great number of our soldiers without amputation.

Sections of nerves may also be grafted to remedy muscular paralysis caused by the rupture of a motor nerve. I myself truly believe that even entire organs may well be grafted. The grafting of kidneys has never yet been performed upon man, yet in certain cases such grafting alone can save the lives of patients. It is possible, for instance, to remove a kidney affected with tuberculosis, and its fellow would suffice perfectly for the normal function of the body, becoming hypertrophied in order to compensate for the other kidney's loss. But when the second kidney is affected in its turn, death is inevitable, and only the grafting of a fresh kidney can possibly save the patient.

I once had a splendid chance to perform this operation; unfortunately I was prevented from doing so by circumstances which bear telling. In 1913, some criminals, known as Bonnot's gang, were condemned to death. There were, if memory serves, four of them. One, who was called Raymond La Science, offered his body for scientific experiments before it was delivered to the executioner. At the time, I was treating a young Syrian of nineteen, a girl of rare beauty, who had lost one kidney some years before, through tuberculosis. Her second kidney had just become affected, which meant certain death in a short time. Through an attorney, I applied to the State Prosecutor, begging him to permit me to take one of the bandit's kidneys and graft it upon my young patient. I was told that the thing was utterly impossible. Were the assassin to succumb under the knife, the public would protest against such cruelty; but it would be even worse if he survived, and the young girl lived. This bandit, who had several murders to his credit, would then pass for a benefactor, with the most deplorable effect on contemporary morality. He was executed, and my young patient died six months later.

This tragic event convinced me that the future of grafting did not lie in borrowing organs from men. I had the good fortune to reveal to them the resources offered by monkeys, who, alone among animals, are related to us by their organs and their blood.

The grafting of glands is a fairly recent accomplish-

ment. I created it all of a piece. My method, applied by my pupils the world over, has already revitalized thousands of men, and some five score women; it has also restored their intelligence to certain backward children through grafting of the thyroid gland, whose atrophy annihilates the functioning of intelligence.

Among those who have worked along the same lines, I must mention, in the first place, Brown-Sequard, the founder of opotherapy. He belonged, as I did, to the Collège de France, and had advocated the injection of glandular extract. And I must pay tribute to Alexis Carrel, who at the beginning of the century performed the suture of the vessels on cats and dogs; then to Lespinasse, to Morris and to Lydston, all of them American surgeons of progressive minds, who performed some glandular graftings; and to Stanley, who revived Brown-Sequard's original idea and who administered glandular injections. To this list, I gladly add an illustrious Viennese scientist, Dr. Steinach, who accomplished the most significant graftings upon rats, recording the same results that I have obtained in grafting upon men.

So many scattered works, so many isolated attempts, formed a favorable atmosphere for a definitive synthesis, completed not only by the discovery of a technique assuring the survival of the transplanted glands for several years, but also by the discovery of a store of spare parts for the human machine, in the bodies of monkeys.

From birth, each of us is heir to the past. Besides our direct, natal heritage, we enjoy the total heritage of the knowledge bequeathed to us by foregoing generations. The works they willed to us impregnate our brains, mold our thoughts, cultivate our feelings. We are what history has made us; we are the last stage of a millenary past of civilization. As we evolve from our primitive state, from our ancestral ignorance, and from our animal ferocity, the centuries, as they roll by, enrich our brains and soften our hearts. Unhappily, the laws of heredity teach us that sometimes there occurs a sudden turn backward, a resurgence of animality, a need of cruelty, an instinct of destruction. . . .

I should like to conclude this chapter by recalling the thoughts of a philosopher who lived five centuries before our era and who pierced the deepest and most mysterious secret of nature, a secret revealed to us by physicists only in the twentieth century. This man was the miraculous forerunner of contemporary thought.

That the astronomers of antiquity were able, without benefit of glass or telescope, to make some very true observations of Earth's movement and the position of the planets is certainly remarkable. Still they had eyes to see and the whole starry sky as the field of observation. Similarly, the idea of the evolution of species, however genius-like, could readily have originated in close observation of animals of the various countries. But when,

without a prop, without observation or fact or anything else to guide him, a philosopher proceeds, through purely intellectual means to divine the inmost and invisible composition of matter, then we are faced with an instance where the human spirit, for once, seems to merge with the inmost hermetic spirit of nature. The enigma is such that we may suppose the whole secret of the universe is virtually potential in the human mind. Only recently, thanks to the progress of our means of investigation, to chemical reactions that reveal the composition of matter reduced to its extreme, to electrical apparatus of extraordinary delicacy, our physicists have been able to demonstrate that all matter, solid, liquid, or fluid, all steel, all wood and all water, all is composed of small grains which we call molecules. With these molecules, we enter into a world of infinitesimals which it is difficult, or rather impossible for us to imagine, a world of grains of millionths of a millimetre in size. They, in turn, hold at their core a nucleus which differs according to the substance to which it belongs.

The molecules of all matter are in continual movement. These infinitesimal, invisible grains move in a perpetual dance in the heart of matter, so that everything that appears to us to be motionless and compact, is in reality urged by a continual movement—but this movement takes place in the depths of matter, among ultra-microscopic grains, so that it escapes us utterly. None of our organs can apprehend it. Only some hyper-sensitive

apparatus and some chemical reactions have been able to reveal it to us. We stand aghast before this mystery, the most incredible of nature's mysteries. Well, here is what we find in the writings of the Greek philosopher, *Leucippus*, six hundred years before Christ:

"The universe is infinite, its ponderable part is composed of infinitesimal particles, of atoms of determined shape, variable according to substance, whose infinity moves in space, continually and accidentally clashing against one another."

This is precisely what we learned twenty centuries later, thanks to technicians who possessed a special, ultra-perfected apparatus, finally built in our period after thousands of years of scientific evolution. Do we not marvel at pure mind, which needs no apparatus in order to guess the ultimate elements converging to form matter? Truly, the world finds its reflection in the mind.

When at length our intelligence has penetrated all the secrets of nature, when our ingenuity has created all means of action, we shall become the masters of nature.

CHAPTER XIII

THE ORIGIN OF GENIUS

Genius is an inborn gift which reveals itself virtually from birth. Grotch played the piano at the age of two, Mozart composed at four; Brunswick solved arithmetical problems, and traced geometrical figures in the dust at the age of three; at four, Ampère solved impressive problems in mental calculation. Several other examples have already been cited in the chapter on the precocity of genius.

Thus genius is already found in the seed, in that small, invisible cell which carries within it the entire past of what we ourselves will become. Everything springs from this seed, virtually everything is found therein; this initial cell holds our complete heredity, our physical, our moral and our intellectual attributes. According to the contents of its inner constitution, we may possess genius which may well reveal itself from infancy, or we may even be born imbeciles. We are the children of that cell, with all the qualities or faults it owns; we *are* that cell itself, in a new form which it has attained. Accordingly, it is in that cell that we must seek the origin of genius.

The origin of genius has always been enigmatic, especially since it often springs from the people, or from

ignorant parents who seem innocent of any such quality. Pasteur's father, for instance, was a tanner, his grandfather a serf who had bought his freedom for ninety francs. Newton and Laplace were sons of farmers, Le Verrier, the son of a customs-house official; Carlyle's father was a mason, Jean-Jacques Rousseau's a watch-maker, Rembrandt's a miller. Greuze and Watteau were the sons of master tilers, Chopin and Haydn, of wheelwrights, Gluck, of a forester; Ampère, of a merchant, Dante, of a modest money-changer; Victor Hugo's father was an obscure major, his grandfather, a carpenter. Spinoza and Heinrich Heine were sons of merchants, Leonardo da Vinci's father was a notary, his mother, a peasant. Goethe's father was a lawyer, Voltaire's a notary, and Michelangelo's, the podesta of Capresse, who hated the artist's profession. The history of Descartes' family for two centuries does not disclose a single ancestor who could even remotely recall the qualities of the philosopher who set down the *Principles*.

Thus, a sublime gift is transmitted from birth to a being whose nearest relatives displayed no quality that might foreshadow the arrival of a genius in their families. These parents were but the vehicles of germinal cells endowed with the attributes of genius. Whence come these wondrous cells whose union creates a genius?

From the depths of bygone generations, through the obscure channels of heredity, come these genius-bearing cells, the more obscure and difficult to distinguish in the

human species because the migration of peoples, centuries of slavery, and religious and political persecutions have produced so inextricable a mixture of races as to make it impossible to use the term "race". This is as true in Europe as it is in the United States. We cannot speak of the existence of races; we may at best speak of mentalities—the French, the German, the Italian, the English, and so on.

The descendants of Pythagoras or of Sophocles, scattered throughout the earth, retained germinal cells deriving from these geniuses; centuries later, these cells reunited in order to form a Newton or a Shakespeare.

Germinal cells never die, but are transmitted from one generation to the next. In that lies our real immortality.

These germinal cells, male and female, combine in the act of fecundation to form a germ from which, by a gradual growth for nine months, the child acquires the development necessary to life. These male and female cells are composed of a nutritive substance inherent in the germ—protoplasm—and of a nucleus which is the essential part, the only part that contains the heredity of both father and mother.

Under the microscope we observe that each one of these nuclei is composed of forty-eight filaments called chromosomes, divided into a multitude of granules.

Now, at the moment when the male cell joins the female, their respective nuclei immediately eliminate twenty-four chromosomes, and then unite to form a single

nucleus of forty-eight—twenty-four male and twenty-four female chromosomes which will build the future being and endow him with the physical, moral and intellectual qualities of his parents. In cases where the twenty-four male chromosomes come from a genius, and the other twenty-four from a woman as highly gifted, their fusion will bring to birth a child of genius.

This direct inheritance of genius is unfortunately quite exceptional. Woman is rarely possessed of high qualities equivalent to her husband's; her twenty-four chromosomes, inferior in quality, do not complement those of the genius. Thus boys and girls are born more or less intelligent, more or less gifted, but absolutely without genius. Nevertheless, all of them possess the twenty-four genius-bearing chromosomes of the father, and transmit them in successive marriages from generation to generation. Whole centuries may elapse until the day when some happy chance permits the union of a man and woman, each the remote descendant of children of genius and utterly unaware of this direct descent, lost in the multiple confusion of the ages. Each of them, possessing the twenty-four chromosomes of genius, will at long last be able to reconstitute the ancestral nucleus of the forty-eight filaments requisite for the formation of a new genius. And so the latter appears, with his forebear's qualities adapted to the spirit of the times.

Napoleon kept a bust of Julius Caesar in his study because he identified his genius with that of the great Ro-

man. Without knowing it, he may indeed have inherited, from Caesar, qualities ever-present in the germ cells of Caesar's male and female descendants, scattered throughout the world across the centuries. Napoleon's father and mother might well each have possessed twenty-four chromosomes (of Caesar's) which, fusing after two thousand years of migration, could have formed a germ of forty-eight genius-like chromosomes capable of giving birth to Caesar-Napoleon.

The theory I have just enunciated in regard to the origin of genius may also explain the fact that, with a few rare exceptions, the man of genius is alone among his brothers and sisters. One of the countless instances in the biographies of famous men is that of Napoleon's brothers, who were completely undistinguished. The explanation seems very simple.

According to my theory, father and mother each bore twenty-four chromosomes of genius, whose union ensured the birth of a child of genius. It does not follow that *all* the children of the same parents inherit the same quality and all become geniuses. Each parent has not only twenty-four chromosomes bearing the heritage of a genius, each has twenty-four other chromosomes as well, since the human cell always contains forty-eight. Now by rule these last-mentioned chromosomes bring other heritages, alien to the heritage of the ancestor of genius.

To make the argument quite clear, let us suppose that

each germ cell of the father and of the mother contains twenty-four red chromosomes (genius) and twenty-four white (non-genius). Each time the male cell unites with the female cell in the creation of a child, male and female cell each eliminates twenty-four chromosomes in order that the remaining twenty-four may, in uniting, form a new nucleus containing forty-eight. Thus, the union of these two cells requires the prior loss of half their filaments, as we have shown. But which half will the germ cells eliminate?

Multiple combinations are possible. It would require a happy accident for each of the two cells to eliminate all its white chromosomes, retaining all the red to ensure, by their union, the birth of genius. If, however, all the red chromosomes have been expelled by both parties, or indeed by one party, no genius will be forthcoming. Thus, even in genius-bearing families, the birth of genius is submitted to chance combinations of the chromosomes; a happy combination is seldom repeated. The brothers Bellini, Giovanni and Gentile, both famous painters in sixteenth century Italy, provide a rare instance of this possibility.

Geniuses are generally members of large families, and are the only ones possessing the qualities of genius. They are almost never the first-born. Wagner was the ninth child; Mozart and Beaumarchais the seventh, Tolstoy the fourth, Shakespeare, Voltaire, Victor Hugo and Pasteur the third. Goethe provides the only exception I know.

Yet I believe that, under quite special conditions, another origin and method of the formation of genius may be considered. The father, grandfather and certain remoter forebears of Mozart had a gift for music; they played violin, clavier and harpsichord, and they composed music. A particular brain centre, always the same one, was transmitted directly from generation to generation, always in process of perfection and hypertrophy, and may finally have acquired the quality of genius and permitted Mozart to play and to compose at the age of four without any study, because in his brain all had been learned previously.

The case of *Johann Sebastian Bach* is even more instructive. His ancestors, all musicians, can be traced for seven generations and through two centuries, from the sixteenth to the eighteenth.

1. The founder of the family, Weit Bach, a baker, later a carpenter, displayed a taste for music, singing and accompanying himself on the guitar. He lived in the middle of the sixteenth century, around 1550.

2. His eldest son, Hans Bach, a baker and subsequently *Kapellmeister* to the Duke of Gotha.

3. Hans' eldest son, Johann Bach, organist of the Church of Erfurt.

4. Johann's son, Heinrich, organist of the church at Arnstadt.

5. His son, Johann Christoph, organist at the Court of Eisenach.

6. Johann Ambrosius, son of Johann Christoph, musician at the Court of Eisenach.

7. Johann Sebastian (1685–1750), the most famous of the Bachs, son of Johann Ambrosius.

The Bach dynasty numbered more than twenty eminent musicians. It was customary in the family to foregather several times in the year, such reunions being purely musical affairs. On one such occasion, one hundred and twenty Bachs were assembled, all of them playing music.

For over two centuries, also, the Bernouille family of Swiss mathematicians produced fourteen generations of scientists, three of whom attained celebrity.

Raphael's father and three other forebears were distinguished painters.

The heredity of a genius-like quality through progressive hypertrophy of a brain centre is thus possible. The entire lineage of a family can one day be embodied in one of its members; but such cases are unfortunately rare. Some favorable circumstances generally contribute, such as the intelligence and broad culture of the woman, sometimes her gift of genuine talent. This is particularly noticeable in musicians' families.

The chromosomes of a great musician uniting with those of the wife, herself a capable musician, can ensure the preservation of the father's genius. Following the custom of the guild system of that day, the Bachs contracted

numerous alliances with the daughters of former music masters, organists and other musicians. But it is scarcely a woman's talents that generally rule man's choice; her charms are sufficient without his bothering about the quality of her chromosomes! The result is that the man's twenty-four chromosomes are neutralized by the woman's; hence the birth of children who in nowise equal the father. If we could do in families of genius as was done in the dynasties of the Pharaohs and Ptolemys who reigned in Egypt after the death of Alexander the Great—marry brothers to sisters, each of whom possesses the twenty-four chromosomes of their father—we would stand a far better chance of creating great men.

Since such a practice is, however, scarcely appropriate today, children of a genius of either sex marry outside their families and stray ever further afield throughout the world. Eventually we witness the miracle of the birth of a genius in the family of a blacksmith, married to a peasant woman, both of whom bear and at last fuse chromosomes of genius inherited from a distant ancestor.

I believe my conception of the origin of genius is plausible. We cannot seek its origin elsewhere than in the fertilized cell, the germ whence we came, and which holds all that we shall ever be. In this germ the chromosomes alone contain all our qualities condensed in little grains, which will form our future brain. If we refuse to cherish empty catch-words such as "gift of nature" and "miracle

of creation", we must assuredly turn to the chromosomes in order to find the key to the riddle.

For any "miracle" is but a sign of our ignorance. The savages had many; we have retained some, but, fast as our knowledge increases, they disappear.

CHAPTER XIV

THE STRUGGLES OF GENIUS

Every man of genius whose work disturbs the accepted ideas must wage a bitter struggle in order to overcome the obstacles set along his path. I do not speak of the struggle for existence and for material needs. With rare exceptions, that is the lot of all men of genius at the outset of their careers. Almost all suffered the cruel anguish of the uncertain morrow. Rich families are not privileged to create geniuses; these are far more often born to blacksmiths or peasants than to bankers.

The struggles I wish to mention here are those genius must wage in order to compel the acceptance of a new philosophical concept, an original artistic formula or a scientific discovery. The innovator appears as a revolutionary; in his path rise all the champions of routine, of hallowed ideas, of hidebound habit. And it is among men of his own social category, of his own profession that rivalry breeds jealousy, and envy unleashes the struggle.

Assuredly, when a man is outside the range of any possible competition, he is inclined to admire a work at which he can take no umbrage. There is no jealousy between painter and astronomer, or between poet and mathematician; it is only among members of the same profession

that jealousy rears her ugly head. The rival who appears more talented than we are, and who outstrips us, establishes our own inferiority, and stirs our jealousy, if not our hatred. As Lucretius says: "Envy, like lightning, is apt to strike the heights rather than the mean level below." For to be outstanding is the very attribute of the genius and the innovator.

The success a better man wins aggravates that envy. Descartes said it all very succinctly: "Envy is a form of melancholy mingled with hatred, inspired when we see good fortune visiting those whom we believe worthy of it."

Faced with a man of talent or genius who is beginning to assert himself, all his colleagues, without the least connivance, agree to maintain the deepest silence insofar as he is concerned. They simply ignore his existence; of their own will, simultaneously, they seal their lips. This conspiracy of silence is one of the most famous of envy's stratagems, especially among scientists. But such an attitude cannot prevail forever. If the qualities they sedulously belittle shine forth, ever more brilliantly, it would appear ridiculous to continue to feign ignorance.

At once, their tactics change, without any need of pre-arranged planning. The antagonists, one and all, urged on by the same sentiments, understand each other and join in a common campaign of deprecation and slander. The man of genius, a creator, is but a tyro, he is still unknown; his opponents are often established figures, enjoying the

prestige of an acquired position, and even the admiration of their contemporaries. Alas! genius persecuted encounters no enemy more savage and relentless than the man high in the hierarchic system, fighting with all the kudos of an authority long hallowed by the masses and by the government.

What agony for a person who has passed as the most talented painter of his times, or the greatest scientist, or the most popular composer, or the darling of literature, suddenly to see a newcomer, whose production in his particular field is dazzling in its supreme quality, even though that newcomer is a friend of his. The French writer and philosopher, La Bruyère, puts it exactly: "The joy we experience as a friend rises to fame is somewhat tempered by the slight pain we feel at seeing him equalling or surpassing us."

Among scientists, there are two types of enemies. First is the great *savant*, whose pride is wounded because the renown of a newcomer exposes him as incapable of such a discovery; next, the obscure colleague who, in assailing the new discovery, hopes to attract attention to himself.

On this score, I am reminded of an anecdote related to me when I was in Northern India, at Lahore, where there are no elephants. When an elephant appears there, the superb beast is at once the centre of attraction, and such commonplace animals as dogs pass unheeded. But if a cur suddenly starts barking furiously, and even snapping at the elephant's feet, attention is immediately brought

back to the wretched, insignificant little canine, who is praised for his great courage in barking at the colossus. . . .

Men, however, have not the justification of being slaves to their instincts, and they have more to gain. Let a rabble of obscure confrères fall upon a genius, thereby delighting the great scholars who dare not openly attack him themselves, and the little men, richly rewarded by the great, profit handsomely by their baseness.

Envy and jealousy are so natural that the Greeks attributed them to their very gods. Did not Aesculapus, the deity of physicians, fall a victim of Jupiter's jealousy? With marvelous skill, Aesculapus resuscitated Hippolytus, son of Theseus; whereupon Jupiter, wrathful at this usurpation of his right of life and death, struck the healer with lightning. An example of such lofty origin must needs have found followers among mere mortals at all stages of history.

When, five hundred and fifty years before our era, Confucius sought to teach the gospel of virtue to the Chinese, he had to flee his native land; Socrates, wisest of Greeks, was sentenced to death by his Athenian judges; Plato, sublime thinker, was sold as a slave by Dionysius, tyrant of Syracuse; Aristotle, the creator of biological science, the great naturalist, logician and philosopher, was banished from Greece and poisoned himself in despair; Spinoza was cursed by the Jews, Kant by the Protestants, Galileo by the Catholics; Wagner was reviled by his fel-

low artists and mocked by the public; Bizet was harrowed by the frigid reception of *Carmen*; Dostoievsky was sentenced to hard labor; Baudelaire suffered as the courts banned one part of his work; Pasteur was detested and hounded by his fellow members of the Academy of Medicine.

The list of the martyrs to science, art and thought, is a long one; few triumphed during their lifetime, almost all were honored after death.

It would require many volumes to record the struggles of the geniuses who enriched humanity with their ideas, their discoveries and their novel artistic formulas. I shall merely touch upon the struggles of the illustrious men I have mentioned above.

CHAPTER XV

THE STRUGGLES OF POETS AND WRITERS

Of all the writers who have had to struggle against envy, jealousy, hypocrisy, the rigors of censorship, government persecution, the great Russian, *Dostoievsky*, was to suffer the most atrocious fate. It was his misfortune to live at a time when Russia was ruled by Nicholas I, a savage monarch, a sort of bloody monster who terrorized the country. Dostoievsky, already famous for the publication of *Poor People*, was accused of having commiserated with the wretched lot of the Russian peasants, who were reduced to slavery and sold like so many heads of cattle. For this violation of the established code, committed in thought only and followed by no act whatever, on his part, the writer was condemned to four years at hard labor.

The crowned executioner who sat on the throne of Russia added an unimaginable refinement of cruelty to the sentence. Dostoievsky was given to believe that he had been condemned to death. He was dragged on to the scaffold, where a priest read a sermon on St. Paul's text: "The wages of sin is death," explaining to the unhappy man that nothing came to an end here below, and that an eternity of beatitude awaited those who repented. No

doubt about his fate could possibly linger in Dostoevsky's mind; the priest's sermon robbed him of his last hope.

The executioner approached the condemned man, who was made to kneel. Above his head, the executioner broke the sword, as a sign of his disgrace. Then they clothed him in a white sackcloth robe, with long sleeves and a hood. They bound him to the stake of infamy. The executioner pulled the hood over Dostoevsky's eyes; a brief order rang out; three riflemen stepped out of rank and formed in line before the condemned man. The soldiers loaded their rifles, took careful aim. A cry: "Fire!" and then—and then, at that terrible moment, Dostoevsky was informed that the death agony had been inflicted upon him simply as a supplement to his sentence of hard labor.

His life as a convict was one long, horrible martyrdom. It set an indelible seal upon all his works. His heroes are all wretched men, overwhelmed by remorse, torment and the most horrible of nightmares. All of them possess the supreme unhappiness that was Dostoevsky's, their souls are those of an innocent ex-convict, of a man who, having borne the agony of death, lives haunted by the horror of his memories.

At about the same time, in France, a celebrated poet named *Charles Baudelaire* was likewise haled before the courts of justice; his offense was the publication of a book of poetry, *Flowers of Evil*. But manners differ in different countries. In the Russia of 1848, an author was con-

demned to hard labor for expressing a charitable thought about the unhappy serfs; in the France of 1857, the tribunal simply ordered the suppression of six out of one hundred poems, those six being judged offensive to public morality.

The fact is that *Flowers of Evil* was a bitter and daring book. Vice was depicted with the starkest reality; an erudition of all evil found its expression in a superb science of word and rhythm. Yet that vice, however eloquently evoked, did not triumph. The book's lesson was unmistakable: chastisement followed the crime, illness followed excess, and, hard upon the heels of vice, came melancholy, boredom, and the procession of shames and sorrows that degrade and devour us.

What influence would these poems exert upon the reader? Which would prevail, the lure of vice painted in such fascinating and heady colors, or the fear of chastisement after lust was sated? This was the question before the judges. The brief filed by the prosecution and the defendant's plea will allow the reader to decide for himself.

M. Pinard was the Deputy Public Prosecutor. In his indictment he said:

"Charles Baudelaire belongs to no school. He is *sui generis*. His principle, his theory is to depict everything, to lay bare everything. He will probe human nature in its most intimate crannies; to present it, he will invent the most vigorous, captivating accents; he will exaggerate nature, especially in its hideous aspects; he will magnify

it out of all proportion, in order to create an impression, a sensation. . . .

"The argument we shall hear runs as follows: 'Here is a tragic book; its very title shows that the author has wished to portray evil and its treacherous caresses in order to protect men against it. The author deliberately named his work *Flowers of Evil*. Accordingly, the book offers a lesson in morality rather than an offense against morality!'

"A lesson! The word is lightly spoken; but here it does not correspond to the truth. Can any man believe that it is healthy to breathe the heady, captivating scent of certain flowers? The poison emitted does not repel one; on the contrary, it goes to the head, it unsettles the nerves, it proves toxic and vertiginous, and it can even be fatal! 'I am painting evil with all its intoxication,' I hear you say, 'but also with its miseries and shame.' So be it. But what about the host of readers for whom you write? Will all these readers of every age, rank and condition take the antidote you mention so blithely? Among your educated readers, among mature men, do you really hope to find so many cold calculators, weighing pro and con, matching poise with counterpoise, enjoying a perfect mental balance, together with a balance of senses and imagination? Men may not admit this, they are too proud, but here is the plain truth: Man is always more or less infirm, more or less feeble. If this be his intimate nature, and it is not reenforced by virile efforts and an iron discipline,

he will acquire a taste for lascivious frivolities, regardless of what lesson the author may provide. Writings of this sort can readily rouse the most unhealthy sentiments in those who are as yet neither impoverished nor blasé.

"Take these many poems in which the author forces each situation, as though he had undertaken to rouse even the lethargic to great excitement. Gentlemen, you, as judges, have but to choose from among them. The choice is an easy one, you will find offenses to morality on practically every page. . . .

"May I add that this book is no ephemeral sheet of paper, set aside and forgotten like your daily newspaper. When books appear, they are destined to endure; they remain on our bookshelves and in our homes, much like the pictures on our walls. If a book has obscene pictures which corrupt people as yet innocent, if it wakens morbid curiosity and offers the spice that whets the appetites of blasé senses, then it becomes an ever-present danger.

"Be merciful to Baudelaire, a man of troubled and unstable nature. But, as you pass sentence, be strong to condemn at least certain poems in this book, thus sounding a warning which has become all too necessary."

The plea by Maître Gustave Chaix d'Est-Ange, Baudelaire's counsel, was, in part, as follows:

"The public ministry has just told you: Charles Baudelaire's theory is to depict everything, to lay bare everything. He will probe human nature in its most intimate

crannies, he will invent the most vigorous, captivating accents; he will exaggerate nature, especially in its hideous aspects; he will magnify it out of all proportion. . . .

“At the outset, the poet’s title warns you; it stands there boldly, sentinel-like, to proclaim the nature and species of the work; the poet proposes to show you evil, the flora of the unhealthy places, the fruits of venomous plants. His title tells you so, no less surely than Dante’s title of the *Inferno* indicates the place of that masterpiece in the total work. If Baudelaire exhibits all this to you, it is solely in order to excoriate, to fill you with hatred, disgust and horror of vice.

“After the title, I read you the book’s epigraph. It contains the whole thought of the author, the whole spirit of the book; it is a sub-title, so to speak, more explicit than the first, which it explains, comments and develops:

*All evil things, we hear, should be cast deep
In wells abysmal or sealed fast in sleep
Under the tomb; a chronicler of vice
Infecting present and future, transgresses twice.
Yet was sin born of wisdom’s utterance?
Was virtue ever sired by ignorance?*

“From the very first lines of the book you will find the author’s inmost thought even more clearly marked; he directs a warning to the reader in them:

*Folly and error, avarice and vice
Possess our minds and batten on our flesh,*

*We cultivate each sweet remorse afresh
As beggars feed their parasitic lice.*

*Our sins are staunch, and our regrets, base fears;
For any avowal we make, we claim high toll,
We fall back gladly in the mire, our soul
Thinking to cleanse its sins with craven tears.*

*The Devil holds the wires, and we move well,
Savoring delights from our abysmal shame,
Daily, step by calm step, we tread the same
Darkly putrescent corridor to hell.*

“Put this into prose, gentlemen, do away with rhyme and caesura, seek out what lies in the depths of this powerful, picturesque language, what intentions are latent in the text; then tell me whether we have not heard this same language from the heights of the Christian pulpit; from the lips of the most devout of preachers; tell me whether we do not find the same thoughts, and sometimes, too, the same expressions in the homilies of your rudest, most stern Church father? This then is Baudelaire’s policy, if I may be allowed to use the term; he declares war upon the vices and baseness of humanity; he utters a sort of malediction against all shames which:

Possess our minds and batten on our flesh

He grows indignant because:

Our sins are staunch, and our regrets, base fears

and his is indeed the lofty language of the moralist, on the very first page where he meets the reader and so harshly decorticates:

Folly and error, avarice and vice

It is their vices alone that he seeks to prosecute and castigate in his avenging verses. Surely, you will not condemn him for such sentiments as these?

"Would you condemn him any the more for the method employed, for the technique he resorts to, for what I may call his manner? To paint vice, but to paint it in its most violent colors—in exaggerated colors, if you wish—in order the better to bring out its odious, repulsive aspect, that is Baudelaire's whole method. Certainly, it is old as the earth! Baudelaire cannot be credited with its invention; it belongs to all ages and all literature. No great writer of poetry or prose, no moralist, no profane or sacred orator, but has made use of it. This method, in fine, is no more and no less than that of the Spartans, when they exhibited the drunken helot as a spectacle in order to inspire their youth with a horror of drunkenness.

"Do you see anything else at the theatre? Can you name a single play in which you are not shown a villain painted in the blackest colors, for you to hate, a traitor whom Providence will not fail to strike down at long last?

"It is true that, by way of contrast, to accentuate his unworthiness and increase the spectator's aversion, you are presented with an honest man, who assures the triumph

of virtue. Here is immanent justice—the punishment of vice and reward of virtue. What else is Baudelaire's system? And it is so constantly and ubiquitously employed because man has yet to discover a better means to correct his fellows. . . .

“A writer who doubtless knew something about these matters and whose authority is certainly of some worth—I refer to Molière—wrote in the preface to *Tartuffe*: ‘The most beautiful expression of high morality is generally less compelling than the barbs of satire; nothing better censures the judgment of man than the portrayal of his defects.’

“I mention Molière and *Tartuffe*; need I here remind you of the fate this masterpiece met upon its appearance, the intrigues compounded by sham zealots, the terrible struggle Molière had to wage before the play reached the boards, and finally, the expression of a king's will before the battle was over. . . .

“Is all this a commonplace, gentlemen? Do we all agree with Molière today? Well, then, why prosecute Baudelaire? He employs the same technique; he displays vice, but in odious form; he paints it in repulsive colors, because he hates and abominates it, because he would make it hateful and abominable.

“Since we are now discussing questions of literary method, will you permit me to quote a few lines from Balzac. They appear in a letter and are of greater interest here because they do not appear in his collected works:

“To moralize his period is the end every writer must strive for unless he wishes to be merely an entertainer; but have the critics any new techniques to offer those writers they accuse of immorality? The only known technique is to bare the sore. Lovelace is the sore in Richardson’s colossal work. Take Dante: as poetry and art, in its smoothness of execution, the *Paradisio* is far superior to the *Inferno*. But almost no one ever reads it; it is the *Inferno* which has at all times stirred the imagination of men. What a lesson! Is it not a terrible one? How will the critics reply?

“Great works endured because of the passions in them. Now passion means excess, and therefore evil. A writer fulfils his task nobly when he accompanies this essential of every literary work with a great lesson. In my opinion, a profoundly immoral work is one which would justify evil and undermine propriety, religion and justice. . . .’

“The affirmation of evil does not constitute a criminal approbation of evil. Satiric poets, dramatists and historians have never been accused of weaving garlands to crown the crimes they relate and produce upon the stage. Baudelaire, in picking and gathering these *Flowers of Evil*, never asserted that they were beautiful to behold, fragrant to smell, fair to gird about our temples, and pleasing to hold within our arms. He never implied that there lay the path of wisdom; on the contrary, merely by naming them, he withered them. Has he ever said anything in favor of the vices which he presented so vigorously in

his verses? Can he be accused of having made them attractive? Or do they stand there hideous, naked, trembling, half-devoured by self, as one pictures them in hell? Let us turn to an authoritative and eminent critic who is one of our great writers, M. Barbey d'Aurevilly:

"The terrible and terrified poet sought to make us breathe the abomination of that ghastly basket which he bears upon a head bristling with horror. It is truly a magnificent spectacle. Since the guilty lover, sewn up in a sack floating away under the black, dank bridges of the Middle Ages, we have witnessed nothing more deeply tragic than the melancholy of this poetry of guilt, with its bundles of vices riding high upon its livid brow. Let us allow it, too, to pass. We may take it for justice, for a part of God's own justice.' . . .

"I cannot better reveal to you the essentially high morality of Baudelaire than by reading the moving hymn in which he speaks his own language, opens his soul to his own thoughts, and abandons himself to a canticle of love and benediction:

*Serene, the poet's gaze roams heaven, to find
Thy splendid throne; he lifts his arms in praise,
As the vast flashes of his lucid mind
Obliterate Earth's fury with their blaze.*

*Blessèd, O God, Who gavest suffering
To cleanse our sins with balm of lordly measure,*

FROM CRETIN TO GENIUS

*Blessèd Thy purest, most essential spring
Whereof the strong, drinking, taste hallowed pleasure.*

*I know Thou hast decreed the Poet, not least,
His place amid Thy happy legion's stations,
Thy bidden guest at Thine eternal feast
Of Thrones, of Virtues and of Dominations.*

*I know that only grief spells nobleness,
Which earth and hell possess not, by Thy curse,
That such as have their mystic crowns to tress
Must awe each age and every universe.*

*Yet all jewels lost of yore, all metals yet
Unknown, sea-pearls unfathomed, gem on gem,
Strewn by Thy hand, could not avail to set
The dazzling facets of this diadem.*

*It shall be hewn of purest splendor lent
By hearths whence light first broke across the years,
Which mortal eyes, for all their dazzlement,
Reflect but darkly, through a mask of tears.*

“Is it just, because a warning seems necessary to the public ministry, to hit upon Baudelaire as choice? Why is it these *Flowers of Evil* you are bent on prosecuting, when assuredly neither the poet nor his daughters have deserved

Such high excess of honor or of shame!

"You know these poems. I cannot read them again here, but let me say in passing that some of them are admirable. Gentlemen, in the council chamber, you will re-read all these incriminated poems, and you will ask yourselves whether that is the kind of writing which constitutes an outrage upon public morality.

"Confident that you will not wish to punish this great artist, I beg you purely and simply to dismiss the case against him."

JUDGMENT

"Insofar as the offense against religious morality is concerned, whereas the charge has not been established, the case against the accused is dismissed.

"Insofar as the charge of offense against public morality and decency is concerned:

"Whereas, the error of the poet in the goal that he sought to attain, and the mode which he followed, despite all efforts of style he may have made, and whatever be the burden of blame pursuant to or proceeding from his writings, could not avail to destroy the sinister effect of the pictures he presents to the reader, and which, in the poems incriminated, necessarily lead to excitement through a crude realism which offends all decency;

"Whereas, therefore, Baudelaire has committed the misdemeanor of outrage upon public morality and decency:

“The Court orders the suppression of the poems numbered respectively, 20, 30, 39, 80, 81 and 87, and entitled: *The Jewels, Lethe, To One Who Is Too Gay, Lesbos, Women Accursèd* and *The Metamorphosis of a Vampire.*”

CHAPTER XVI

THE STRUGGLES OF COMPOSERS

The composer of genius, or the composer merely gifted with a fine talent, who creates an opera which possesses the characteristics to which the public is accustomed, which does not clash with the taste in vogue at the moment, and which remains within the traditions consecrated by generations, is assured of success in advance. The normal, inevitable and human jealousy of his colleague is of small account beside the applause of the spectators.

Mozart, Rossini, Verdi and Gounod won admirers at the outset. Their music, alive with charm and compact of "airs" in which each artist had his own "turn" in the lime-light, afforded a pleasure infinitely welcome to the general public. Then *Wagner* appeared, creating a wholly new art, that bore no conceivable relation to opera as previously offered. He achieved complete fusion between orchestra and the spoken word; the symphony explained and was a commentary on the drama; declamation was most precise, without the repetition of any word; the *leit-motif*, frequently renewed, was the soul of the composition. Out of all these elements, associated and fused in a brain of genius, there emerged a wholly new art-form

that challenged every canon of the past. Wagner's music translates and expresses chiefly the sentiments and the movements of the soul, and the shadings of the emotion. Such external events as were unfolded upon the stage became so many visions explained by the symphonic music.

This music, of vast and powerful sonority, was so different from that which had delighted several generations, that we are not surprised to learn how grossly misunderstood it was at first. The artistic public had to be re-educated, an arduous task which Wagner finally accomplished, but at the price of how many struggles both in Germany and in France. A full account of them appears in Guy de Pourtalès' excellent study of Wagner. I shall merely relate the "Parisian scandal", which accompanied the performance of *Tannhäuser*.

In order to prepare the public for *Tannhäuser*, Wagner organized three concerts, and, for the purpose, hired the Salle Ventadour, a hall in which Italian opera was usually performed.

On June 25, 1860, the first of these three concerts took place before a crowded house, including Meyerbeer, Gounod, Ernest Reyer, old Auber and Field-Marshal Magnan, representing the Court. Wagner had not invited the press. The public appeared well disposed. *Tannhäuser's* March was interrupted by applause. But the newspapers, naturally, were ironic and malicious.

"Wagner is a great musician, but of deplorable tendencies. Fifty years more of this kind of thing, and music will be dead." "A music without melody,"—this was the usual reproach he incurred—"all in formulas, all in combinations," said the *Messenger du Théâtre*. "A revolutionary," cried another gazette, "The Marat of Music." As for the celebrated Belgian composer and musical critic, Fétis, he was preparing to write in his *Universal Biography of Musicians*: "Now that curiosity is satisfied, indifference has succeeded it. This music, heralded as the music of the future, is already the music of the past." However, according to von Bülow, Wagner's friend, compatriot and colleague, the Parisians displayed a far greater intelligence, courtesy and artistic sense than the Berliners.

The second and third concerts were performed to a virtually empty house; free passes had to be distributed hastily at the last moment. But though the hostility of the press inflicted a defeat expressed in terms of a deficit of eleven thousand francs; though Berlioz, in the *Journal des Débats*, published a perfidious article on the music of his former friend, still there were compensations. The French musician's prejudice, so brutally revealed, reacted in the German's favor, gaining him a warm current of sympathy.

Wagner's surprise was great when the popular French writer, Jules Champfleury, sent him a brochure he had written to vindicate him. It grew livelier still when Baude-

laire sent him two of those incisive, spontaneous letters which compensate an artist for the bitterest disappointments.

Others, too, began to rally to the help of the misused artist, including Princess Pauline von Metternich, wife of the Austrian ambassador, Count Albert von Pourtalès, then Prussian ambassador in Paris, and Count von Hatzfeld, his attaché, all three extremely valuable patrons, since they were familiars of the Empress Eugénie. So Wagner's name was mentioned at the Palace of the Tuileries, and M. de Royer, director of the Grand Opéra, received orders to present *Tannhäuser* upon the stage of this, the Imperial Academy of Music. Fould, Minister of the Palace, seemed disgruntled, but Napoleon III had pledged his word to the Princess Pauline and he was adamant. Wagner was ushered into the presence of Count Bachiochi, Chamberlain to His Majesty, and asked about the subject of the drama.

"So," cried Bachiochi, "the Pope doesn't appear on the stage. I was told you had included the Holy Father among your characters. That, you understand, would have been quite impossible. Well, monsieur, all of us now know that you possess vast genius; the Emperor has ordered the production of your opera."

It all suddenly seemed part of a dream; was there not a misunderstanding somewhere? Misunderstanding there was, for in his first interview with M. Alphonse de Royer, the latter asked Wagner to introduce a ballet into the sec-

ond act. Faced with this monstrous suggestion, the author immediately offered to withdraw his work. At bottom, he was no longer eager to pursue this adventure further; it was, he foresaw, doomed to the direst misapprehensions. Heretofore, it had all been chiefly a question of prestige; now, he realized that his instinct had not erred, and that they would reach an impasse. Royer wanted to please the public, Wagner to serve the cause of art. The director insisted: the cardinal point was to satisfy the most exacting subscribers, the members of the Jockey Club, who enjoyed seeing their mistresses dance. Wagner thought the matter over. Perhaps, he reflected, he *could* lengthen the Venusberg scene in Act I.

"Useless, I fear!" de Royer replied, "The 'Jockeys' never turn up before the second act." Nevertheless, Wagner took back his score, revamped it, and composed a Bacchanale, so well integrated and executed that Royer finally accepted the opera in this form.

Never, save in his early days in Dresden, had Wagner been obeyed so punctiliously, so intelligently understood. He lived in continual surprise at the turn events were taking; suddenly, he felt happy, spoiled, moved to indulgence. Never had a musical work anywhere aroused as much talk as *Tannhäuser* in Paris.

Wagner's work was proceeding at a joyous pace. Rumor had it that *Tannhäuser* would mark a great artistic battle. Soon, rehearsals began at the Academy of Music; Wagner's tension of mind increased. "Never before have I

been so generously granted the material needed for a remarkable performance," he confides in a letter to Liszt. "All that I can hope for is that some day a German prince will do as much for new works. . . . Mine have won me such staunch admirers, that, on their mere word, the Emperor gave a truly imperial order which leaves me free to rule everything. I am certain to have the best singers that can be found, and my work is being produced with a zeal and solicitude that Germans are scarce accustomed to."

Everything was of the best quality. The only fly in the ointment was the conductor, Louis Dietsch. Once again the eternal conflict between creator and interpreter arose.

Other troubles soon showed Wagner that his evil star still loomed on the horizon. Fatigue undermined his resistance, and he caught cold. A few days later he was feverish. His physician diagnosed the case as typhoid, with danger of meningitis. *Tannhäuser* had to be put off to the Grecian Calends. For several days, Wagner was delirious. His friends were deeply worried; but his wife and his providential physician nursed him through the crisis devotedly. Presently, his robust temperament got the upper hand, and at last the convalescent was able to return to the theatre, where all rehearsals had of course been suspended in the meantime.

Wagner's powers had not failed during these weeks of absence, a fact noticeable by the increased hostility of the official and professional worlds. Berlioz and Meyer-

beer were openly resentful. Even Count Walewski, Fould's successor, intended to foist upon the composer Royer's *idée fixe* of a ballet in Act II. Wagner stood his ground, but no longer entertained the dimmest of illusions; his ultimate failure, he knew, was certain. For the second time, he sought to withdraw his work, but both the Ministry and the Opéra refused to allow it, since the expenses already incurred were considerable.

At last this so eagerly awaited Parisian première took place, on March 13, 1861, after one hundred and sixty-four rehearsals that had already become part of musical legend. The performances were to become as legendary.

"Wagner brings life wherever he goes," Mathilda Wesendonck used to say. Sometimes, she added: ". . . and revolution, too." This was never truer than at the performances of *Tannhäuser*, during those famous nights which were, to quote Baudelaire, "major artistic crises, mêlées into which critics, artists and public are wont confusedly to loose all their passions." This time, true to type, there were a very great creator, a few champions of his music, a public tense with extreme curiosity, and finally, that handful of idiots, always to be counted upon to howl down a foreign artist who shakes them out of their habitual lethargy.

The first scene of Act I went by without disturbance; the huge house seemed to accept certain passages favorably; but when, after the change of scene, the Warthburg appeared, dominating the valley, murmurs arose here and

there. Wagner, in the director's loge, leaned forward nervously; he assumed that the sound heralded the arrival of the Emperor and his court. He was wrong; it marked a place where the opposition had "planted" a burst of laughter. A few critics—coached by Meyerbeer, so Wagner believed—and the leader of the claque with all his acolytes (Wagner, honor-bound, had refused their services) gave the signal for the gales of carefully regulated hilarity which were to punctuate the performance from then on. The oboe's famed *ritornelle* aroused laughter; so, too, the pilgrim's chorus. Leaning over the balustrade of her loge, Princess von Metternich broke her fan in an angry gesture. The public, vexed at these obviously pre-arranged interruptions, seemed disposed for a time to support the author. At one moment, fighting almost broke out.

During the second act, things calmed down again, but as Niemann, who was playing Tannhäuser, entered, someone in the balcony cried: "My God! Another pilgrim!" and the whole house, its nerves on edge, burst into laughter. Here then was failure, the most stupid, most unreasonable and most terrible of failures. Today, after an interval of sixty years, it may appear to us a glorious failure; at the time it appeared ludicrous and no more. "It was practically impossible to be French and not roar with laughter," a journalist commented the next day.

But it required even greater courage to keep the second performance on the playbill. Yet it took place on the fol-

lowing Monday, March 18. As before, the first act was cordially applauded, especially the final septuor. Already, the author and artists believed they had got the better of the intriguers, when suddenly, in Act II, a gust of hisses filled the air. M. de Royer turned towards Wagner: "That was the 'Jockeys'," he explained with an air of resignation. "The game is up."

And indeed, the gentlemen members of the most aristocratic club in France had banded together to prove their attachment to the traditional ballet, of which they were deprived, and to proclaim their taste for the music they preferred. There were a few countering cries of protest, a few cried "Throw out the Jockeys", but the Emperor himself dared not deal sternly with these dandies, almost all of whom belonged to the Imperial Household.

Nevertheless, the performance continued through these squalls. Interrupted by catcalls during his grand solo of the third act, Niemann threw his pilgrim's hood over the heads of the musicians towards the orchestra seats, as one might throw a glove in challenge, and, bowing before His Majesty's loge, spoke a few inaudible words. A moment of complete silence ensued; then the tempest broke forth the more violently, because artists and musicians were bold enough to pursue their task. Whereupon Niemann began to sing intentionally off-key; Bülow wept for vexation; another devoted friend, Kietz, had shouted himself speechless, heaping insults upon the

intrepid hissers. Wagner, for his part, seemed calm, but it is not difficult to imagine what hatred may be brewed in the depths of a heart put to such a trial.

He insisted that the third performance be the last, and on a Sunday, a non-subscription night. For all that, the "Jockeys" reappeared to a man, this time equipped with little silver whistles, upon which had been engraved their orders, "For Tannhäuser." Supporters and friends of the composer gathered en masse; the struggle was even fiercer than before, the interruptions more vehement. Sometimes the artists had to wait for ten minutes before taking up their cues again. Wagner stayed at home, drinking tea and smoking his pipe. Next day he withdrew his opera for good and all.

These three performances had cost the Opéra two hundred and fifty thousand francs; after balancing all accounts, the entire year devoted to this Parisian début netted Wagner the sum of seven hundred and fifty francs. But he harbored no regrets; *Tannhäuser* was, with *Rienzi*, his most instructive victory.

"God grant me such a failure," Gounod commented. Berlioz said nothing; but what worlds that silence said. Jules Janin, Erlanger, Catulle Mendès and Prince Edmond de Polignac proclaimed it an honor to declare themselves Wagner's friend. He was elected to membership in a great and exclusive club that rivalled the Jockey Club. People were proud to treat as an international personage this revolutionary, whose aesthetics, whose failure and

whose philosophy would reign supreme on the morrow. For, truly, defeat alone can extend our limits. Certain fervent admirers even proposed to found a Wagner theatre; and while the German public had never, like the Parisian public, shown him direct hostility, by the same token his art never found truer and more lasting favor than in France.

Three weeks after this enviable setback, Baudelaire published his pamphlet, *Tannhäuser in Paris*; in it, the author of *Flowers of Evil* prophetically assured Wagner that the future would avenge these insults. "Those who believe they are rid of Wagner are rejoicing too soon, we can assure them. . . . Indeed, they cannot really understand the swing of the pendulum, in human affairs, the ebb and flow of human passions. Today, the reaction has already set in; stupidity, routine and envy, pledging joint aid, sought to bury this work." And, in point of fact, the reaction set in at once.

Wagner left Paris with indifference; but "a man becomes all-powerful when he does no more than play with the world." The fact was that Wagner belonged to an age in which tomorrow alone counted; today meant less than nothing. His pride as a creator was henceforth too firmly established for him to worry about himself.

The triumphant ascent of this powerful genius is well-known, culminating, as it did, in the creation of the theatre at Bayreuth, where I have often experienced the rarest of joys and the noblest of emotions that music can evoke, as,

day by day, his operas keep the audience in a state of mounting enthusiasm.

Wagner has entered the realm of immortality.

Among the French composers influenced by Wagner, *Bizet* holds the leading place. He assimilated what suited his personality, but was still able to remain himself; and he created one magnificent work of a wholly new pattern, *Carmen*.

A few years ago, Paris celebrated the thousandth performance of *Carmen*; but the first performance, on March 3, 1875, met with hoots and jeers. The public expressed its contempt of the composer, the critics were unjust, harsh and cruel; even the director of the Opéra Comique, where it was performed, dismissed it as "Cochinchinese music; you can't understand a thing about it".

Others averred that Bizet belonged to a new sect whose doctrine consisted in vaporizing the musical ideal, instead of confining it within definite contours. This school, with Wagner for oracle, considered the *motif* out of fashion, and melody superannuated; in such works, song, dominated by the orchestra, had become only its weakened echo. In *Carmen*, the rivalry between instruments and voice illustrated the error of the new school. Regret was expressed that so young and so gifted a composer should have followed in the wake of Wagner's tug. *Carmen* was actually declared to be neither scenic nor dramatic.

Such criticism may well surprise us. What did these

people want to dramatize the situation? Was not *Carmen*, stabbed by Don Juan, strong enough meat? His opponents formed a conspiracy against Bizet, and proceeded to harass and taunt him. At the first performance, they dared to say that the Spanish gitana sang like a Walkyrie and that Bizet's orchestration resembled his Saxon master's.

Truth to tell, *Carmen* marks an essential date in musical history. Despite the concessions Bizet had to make to current taste, *Carmen*, as René Dumesnil justly observes, retains an energy of accent and lively color that the years have not dimmed.

Performed in lyric theatres the entire world over, and everywhere acclaimed, *Carmen*, like the *Pearl Fishers* and *L'Arlésienne*, give proof that any work, however admirable, which breaks with the past, remains misunderstood by the public at large and becomes the butt of furious attacks and ridicule by all those who defend routine.

Happily, in the end, the work of a genius always prevails. Unfortunately for the author, it is often too late. Bizet died at the age of thirty-seven, after the earliest performance of *Carmen*. He did not live to enjoy the triumphant march of his work across the world.

CHAPTER XVII

THE STRUGGLES OF ARTISTS

Where could I find a better example of the struggles of artists than in the record of *Benvenuto Cellini*? A marvelous artist in the bloody period that was sixteenth century Italy, sculptor of the admirable Perseus that adorns the Loggia dei Lanzi in Florence, artisan of the celebrated golden salt-cellar of Francis I, creator of thousands of *objets d'art*, medals and seals, he was forced to defend himself against the treachery of rivals and the assaults of bandits. The earliest threats leveled at him were always death-threats. Wounds of vanity, great or small, and fits of rancor, more or less justifiable, inured him to the most incredible challenges. It seems miraculous that, with his impetuous and uncontrollable courage and daring, he ever escaped the eternal threats that dogged his footsteps.

His fierce, passionate life, with its mad gestures and paroxysms of fury, contrasts strangely with his work as an artist. With his hands he molded the most delicate objects, in an art at once precious and graceful, mannered on occasion, but always a wonder of exquisite patience, the creation of a soul haunted, it would appear, solely by the gifts of grace and delicacy. The most irascible and furious son of the Italian Renaissance, a man with a bonfire blaz-

ing in his head, an icy stiletto poised in his hand, and fury, like a tempest, raging over his whole being—this man touched the most precious metals and the rarest of gems and transformed them into objects of finished elegance.

Of his numerous and sanguinary struggles, I shall deal but with those which he was forced to wage against rivals jealous of his artistic accomplishment and fame.

One day, as the crowd was filing past the bier of Pope Clement VII in St. Peter's, Benvenuto met the Milanese jeweler, Pompeo, who had spoken ill of him to the late Pope. Seeing him, Benvenuto brandished a short, slender, sharp dagger, scattered the throng, and seized his detested competitor by the throat.

"I raised my arm," he tells us, "to strike him in the face. But he, frightened, turned his head, and the dagger struck just below the ear. I dealt but two blows, for he fell dead at the second."

Immediately, Cardinal Cornero despatched thirty soldiers, armed with long halberds, pikes and harquebusses, to escort Benvenuto under guard to the Cardinal's palace, for safekeeping.

No sooner had he been elected Pope, than Paul III inquired after Benvenuto. He would hear of none but him to strike the new papal currency. He afforded him safe-conduct, and, to justify the exorbitant favor, uttered this typically sixteenth century aphorism: "Know that men who are unique in their profession are above the law." Nevertheless, in order to lend this action a semblance of

legality and to stay any court proceedings, the Pope seized a propitious occasion allowing him to pardon a criminal sentenced to death. At the Feast of the Madonna, the Guild of Butchers, which annually delegated ten men to escort the image of the Savior, was entitled to a pardon for some one criminal condemned to death. The Pope forthwith decreed that this pardon be granted to Cellini. "In order that the use of this ancient custom be observed," His Holiness, "through mercy, indulgence, gracious favor, orders, by the authority of his bull, that his goldsmith be reinstated in his honor, his country, his goods and his dignity."

Benvenuto's influence in papal quarters was short-lived; the calumny of an envious rival brought about his downfall. "He said," the rival alleged, "that Clement VII was the most magnificent prince who ever lived . . . but that Your Holiness was quite the contrary, that the tiara makes a sorry sight upon your head, that you resemble a bundle of hay, berobed in vestments." The Pope pretended to laugh, but, from then on, Benvenuto had the greatest difficulty in reaching the Sovereign Pontiff.

Next, he was accused, on the lying testimony of a wicked artisan of Perugia, of having retained a number of precious stones, the property of the Church, after the siege of Rome. He was apprehended and imprisoned in the castle. In the course of his trial, confident in his innocence, and vexed by insidious questions, he cried:

"For more than a half-hour, gentlemen, you have been

plaguing me with inquiries about a fairy tale, speaking so that I know not whether you chatter or babble, and putting forth your arguments. Ought you not have consulted the registry of the jewels, which has been faithfully kept for over five hundred years? Had you done so, and had you discovered that some were missing, then, and only then, should you have examined me and my accounts. To persecute a man like myself . . . who have done so many brilliant deeds to safeguard this apostolic see . . . ! It was I who created so many ornaments of gold and silver for the Holy Church, who minted so many coins, and so many beautiful and famous medals—and this is the reward a rabble of impertinent priestlings grant a man who has loved the Church so faithfully and served her with such talent! Go back to the Pope and tell him exactly what I have told you. Tell him that he has every one of his gems, and that his Church has given me naught save the wounds and bruises I suffered at the siege of Rome. Tell him that I expected no more than the slight gratitude Pope Paul III promised me, but that I now know what to think of His Holiness, and of yourselves, his servants.”

Although his words proved to be true, the prisoner was not released; doubtless he was detained for the crime of arrogance. Shut up in a dungeon full of water and vermin, he might well have languished there till the day of his death, had he not been freed at the request of King Francis I of France, who wished to attach him to the royal

person, and to entrust him with the execution of some works of art. His journey was troubled by one slight incident—he killed a postmaster whom he considered rude.

Among his numerous chiseled, sculptured and engraved works, his statues and medals engraved in France, we admire particularly the famous salt-cellar of Francis I. A vast number of gold and silver objects of his working were melted down to meet the needs of the treasury of Charles IX.

Benvenuto knew days of happiness in France, undisturbed save for the animosity of an Italian sculptor, Primatrice, who by intrigue deprived him of a commission to execute a monumental fountain. He approached Primatrice, and offered to be associated with him in the work. The other refused.

“Since you will not follow the reasonable road that equity and reason dictate,” Benvenuto thundered, “I shall show you another which, like your own, is neither good nor agreeable. I warn you fairly that if ever I learn that you have spoken in any way whatever about this, my own work, which belongs to me, I will kill you like a dog.”

Primatrice, knowing the violence of Benvenuto’s nature, and how speedily deed followed word, found it prudent to obtain leave to repair to Rome.

Cellini, after a lengthy sojourn in France, also returned to Italy, and settled in his native Florence.

He clashed dramatically with another rival, the sculptor Buccio Bandinelli, who prevented workmen from going to

this goldsmith, turned sculptor, and who sought to do him harm by slander and intrigue. Benvenuto, of course, cordially hated him. Meeting him one day upon the road, he was inspired to do the "bloody act". But seeing Buccio grow pale as death at the sight of him, he cried: "Do not be afraid, coward, I do not deem you worthy of my blows."

His life of passion, battles and frantic toil undermined his health; at sixty-eight, he had lost all his tremendous vitality, was exhausted and frequently ill. He died three years later. In his *Principles Whereby To Learn Design*, he expresses himself as a great artist, in a style worthy of Benvenuto Cellini:

"Order your pupil to copy one of those magnificent hip bones which are shaped like a basin and which articulate so admirably with the bones of the thigh. . . . When you have drawn and thoroughly impressed these bones upon your memory, you will begin to draw the bone which lies between the two hips. It is very beautiful, and is named sacrum. . . . You will then study the marvelous spine of the back, called the vertebral column. . . . It is composed of twenty-four bones known as vertebrae. . . . You must take pleasure in drawing these bones, for they are magnificent. The skull must be drawn in all imaginable positions so that it may never be absent from your memory. I wish you also to grasp all the measurements of the human frame, in order that you may later clothe it more surely with its flesh, its muscles and its nerves,

whose divine nature serves but to assemble and link this incomparable machine. . . .”

He wrote his *Memoirs* at the age of fifty-nine. I quote the first page, written in verse that characterized the man and his work:

*Here my life's struggling story I make plain,
To thank the God of Nature, Who has still
Tended the soul He gave me. By this will,
Diverse and high my deeds—and I remain.
My cruel fate hath warr'd with me in vain;
Life, glory, worth and all immeasur'd skill,
Beauty and grace, themselves in me fulfil,
That many I surpass, and to the best attain.
But man's frail thoughts fly 'fore the wind like sand.
Now know I all the waste, and sorely blame
The precious time I have in trifles spent.
Yet, since remorse is vain, I'll be content.
Welcome I mount, as Welcome down I came
Into the flower of this good Tuscan land.*

CHAPTER XVIII

THE STRUGGLES OF SCIENTISTS

Among the scientists who had to struggle for their ideas, the tragic figure of the celebrated astronomer, *Galileo*, immediately comes to mind. He was made to suffer by his astronomer colleagues, who denied his discovery of the satellites of Jupiter, and who repudiated the observations he had made of the heavens through a telescope by his own invention. He was cruelly castigated by the Holy Office because he voiced his belief that the earth moved around the sun.

It is strange to realize how much the ecclesiastic world has progressed since those seventeenth century days, when its fanaticism too often expressed itself in inhuman acts. For my part, I am happy not to have been born at that distant period. I should certainly have been burned alive, after having been proved guilty of encroaching upon the Creator's will by providing men with the glands of monkeys when their own have ceased to function.

On the contrary, in the modern ecclesiastic world, I was destined to find a more open and comprehending spirit than among my honored colleagues. While our State Faculties of Medicine were still holding aloof and none

had invited me to expound the work I had done on grafting, the Catholic Institute of Toulouse had done so as early as 1926. It was before an audience of priests and seminarians that I first set forth the advantages of grafting genital glands.

On the occasion of this lecture, the venerable rector informed me that, centuries ago, the Church had begun to appreciate the marvelous source of vitality to be found in the genital glands. Indeed, the Council of Constantinople, assembling the loftiest dignitaries of the Church in 889, prohibited *castrati* from entering the priesthood. Catholic priests had no need of these glands to procreate children, since celibacy is prescribed, to set them beyond earthly preoccupations. But they did need them in order to preserve the physical and intellectual powers necessary to carry out their priestly duties. Imbued with these ideas, the Church world in France at once became interested in my work. Churchmen, I may add, helped me procure my first monkeys.

Knowing that missionaries of the Order of the Holy Ghost were scattered throughout our colonies, I applied to their Superior in Paris, Monsignor Le Roy, and begged for information on the colonies where chimpanzees were to be found, how to capture them, and whether it would be possible to furnish me with a supply.

Monsignor Le Roy granted me far more than I had asked. Father Maurice, a Master of Science as well as a priest, was sent to French Guinea to make a field survey

and investigation of the means of capturing chimpanzees without wounding them, and to bring back all useful information. He did still better. Three months later to the day, he himself returned with five chimpanzees, whose glands served for my first human graftings. Incidentally, my second graft was performed on the person of a priest. (My first subject had been an engineer.)

At sixty-five, the priest impressed one as being an old, depressed, ill man. He told me that after the separation of Church and State in France, priests could no longer count on receiving funds from the government. It was therefore increasingly difficult to recruit young men. The old had to carry on the ministry in village churches deprived of their priests; my patient, for instance, had to cover six districts on his bicycle. Weakened by age and by his grueling labor, often awakened at midnight to administer extreme unction to dying men, this worthy man hoped that grafting might quicken his aged body with a little more strength and vital energy, permitting him to accomplish the task which the young refused.

I grafted upon him with the collaboration of my brother, Dr. George Voronoff. I have not seen the worthy priest since, but his letters confirmed the complete success of the operation. Further proof came three years later, when he sent me a beautiful little wooden statuette of St. Anthony. Subsequently, two other priests benefited by the operation of grafting.

One of them was referred to me by my first patient,

who wished his colleague, also prematurely aged and exhausted by his arduous tasks, to benefit by a grafting operation and thus to regain the strength he needed to fulfil his priestly duties. His case presented nothing new. But his gratitude, as he left the clinic after the operation, was touching: "My first mass will be said for you."

The third case was entirely different. This priest was forty-two years of age. He was unfortunate enough to have lost both genital glands at the age of twenty-seven, as a result of tuberculosis of these glands.

For a few years after his loss, there had seemed no apparent change in his body. However, after a period of five to six years, all the hair on his body began to disappear. Fat enveloped his tissues, and he became more and more feeble. A still greater affliction was a tendency toward loss of memory, difficulty in thought-concentration or any extended intellectual effort.

His fame as a preacher was widespread, and his sermons attracted large crowds of worshippers. But now he found it exceedingly difficult to continue his sermons. At the age of 42, his feebleness had reached the point where it was actually painful for him to be on his feet a full hour. To hide his exhaustion from the congregation, he would find occasion to kneel two or three times during the course of one sermon. His parish attributed his actions to zeal and great piety, and the unfortunate priest was able, in these few moments of rest, to capture the thread of his

thoughts again and to regain the strength he needed to continue his sermon.

Some months after the grafting operation was performed, I attended one of his sermons. Not once did he kneel! For over one hour, his vibrant voice resounded magnificently through the vast nave of the church.

I rejoiced that proof was once again at hand that the grafting of monkey glands, which served to infuse new energy into an enfeebled organism, might also serve a high moral purpose.

The cases of these three priests furnished further evidence enabling me to refute the contention that grafting is useful only because it revitalizes the source of sexual functions which ordinarily vanish with the advent of old age.

The grafting of glands is, in reality, effective in augmenting all our energy and in preserving life in its fullest and richest manifestations, in both physical and mental aspects. It is destined to reduce the span of years when old age reigns supreme, and to retard the approach of death, up to the extreme limit of life's possibility.

My three priests, who requested the grafting of monkey genital glands upon their bodies, proved to me that, essentially, the ecclesiastic mind is in nowise intolerant. But in the seventeenth century, manners were harsh and ecclesiastic knowledge shed no light upon the phenomena of nature. Astronomy was in its infancy in those days, and

Galileo was the sufferer. A letter written by him, which is reproduced here for the first time in English, clearly defines the conflict between the science of astronomy and the Roman Catholic Church. By way of corollary, I add the verdict of the Holy Office, a document characteristic of the period.

A Letter from Galileo to the Grand Duchess Christine

"My adversaries have determined to use as shield for their erroneous reasonings the authority of Holy Scripture. The argument they advance, in order to condemn the theory of Earth's mobility and the sun's stability, is based upon the many passages in the Holy Texts wherein it is stated that the sun moves and that Earth is motionless. Thus, since Holy Scripture can never lie nor err, the opinion of such as would wish to affirm the sun's stability and Earth's mobility must necessarily be considered erroneous and damnable.

"In regard to this reasoning, we must first of all consider whether, indeed, it be pious to say and wise to uphold that Holy Writ can never lie. Now, for my part, I do not believe any man can deny that the real meaning of Holy Scripture is frequently obscure and very different from its literal meaning. It follows that if we willed always to stop short at the literal meaning, we could, mistakenly, show that not only contradictions and erroneous reasoning appear therein, but also grave heresies and blasphemies. We would, in fact, be compelled to attribute to

God, hands, feet and eyes; bodily and human affections of anger, repentance, hatred and sometimes, too, a forgetfulness of the past and an ignorance of the future—all of these being capacities which, at the dictation of the Holy Spirit, were thus set down by the sacred writers in order to match the capacity of the vulgar and the illiterate.

“This being a hackneyed doctrine among all theologians, it ought the more forcibly to apply to statements encountered in Holy Scripture that deal with problems of nature which are most difficult to understand and to resolve.

“Accordingly, it seems to me that, in the discussion of physical problems, we should proceed not from the authority of the texts of Holy Writ, but from the experiences of the senses and from the necessary demonstrations. Nature, inexorable and immutable, never crosses the boundaries imposed upon her, nor vexes herself as to whether her hidden reasons and modes of operation are within reach of our human capacity. . . . And God reveals Himself no less excellently in the works of nature than in the holy words of the Bible.

“Two truths cannot be contradictory. It is therefore the duty of wise interpreters of the Scripture to see clearly into the true sense of the sacred texts, which cannot fail to agree with the conclusions of physics, whose evidence through the senses and through necessary demonstrations has been ascertained and established.

"I believe we would be acting wisely, were we to allow no one to bring forward passages from Holy Writ and to undertake to uphold, upon natural problems, the truth of this or of that proposition, which the testimony of the senses and the evidence of necessary proofs might some day contradict.

"Who, indeed, would seek to lay down limits for the genius of man? Who would dare to assert that we have already seen everything visible or everything invisible in the world?

"In the writings published immediately after my discovery of the medicean planets (the satellites of Jupiter), many passages of Holy Scripture were quoted to deny their existence. Today, with these planets plain and clear to everyone's eye, I shall be pleased to learn what new interpretations my opponents will marshal to comment Holy Writ and to explain their simplicity. Theology is wholly occupied with her high conception of God. Therefore, her representatives should not arrogate to themselves the right to issue decrees upon professions which they do not practise and have not studied. To cause this opinion and doctrine to disappear from the earth, it is not enough to seal the lips of one man.

"In order to achieve such a result, it would be necessary not only to prohibit Copernicus' work and the writings of his followers, but further to proscribe all astronomic science upon the earth, and, further, to forbid all men to gaze at the sky. . . ."

The essential passages of the sentence uttered by the Holy Office follow:

"Whereas, last year, there appeared in Florence this book, whose title indicated that you were its author, since it is entitled *Dialogues of Galileo Galilei Upon the Two Fundamental Systems of the World of Ptolemy and Copernicus*; and,

"Whereas, the Holy Congregation was informed that the publication of this book had resulted in augmenting, from day to day, the erroneous opinion of the earth's motion and the fixity of the sun. . . .

"For this reason, we utter against you the unconditional sentence transcribed here below.

"We judge and declare that you have made yourself violently suspect of heresy in the eyes of this Holy Office, in that you have believed and upheld a doctrine both false and contrary to the Holy and Divine Scriptures, to wit, that the sun is the centre of the terrestrial order; that it does not move from east to west, that the earth does move and is not the centre of the universe; and that this opinion may be upheld and defended as probable, after it has been declared and defined as contrary to Holy Scripture; and you have consequently incurred all the censures and all the penalties established by edict and promulgated against delinquents by the sacred canons and other general and particular constitutions; of which penalties we are pleased to absolve you on condition that previously, with a sincere heart and unreserved mind, and in our

presence, you will abjure, curse and abominate the said errors and heresies and all other error and heresy contrary to the Catholic, Apostolic and Roman Church, according to the fashion which we impose upon you:

“And in order that your pernicious error and your serious transgression may not remain unpunished, and may serve as an example to others, in such a way as to discourage them from similar faults, we decree that the book of *Dialogues of Galileo Galilei* be prohibited by public edict, and we condemn you to the private prison of our Holy Office, for a period which it shall please us to determine.”

On June 22, 1633, in the church of the convent of Santa Maria Sopra Minerva, Galileo, upon his knees, and clad in but a shirt, heard his sentence, and uttered the following prescribed formula of abjuration:

“I, Galileo Galilei, son of the late Vincent Galilei, a Florentine, aged seventy, personally in state of judgment and kneeling before your most eminent and most reverend lordships, the cardinals inquisitors general against crimes of heresy in the universal domain of the Christian republic, having before my eyes the Holy Gospels which I do touch with my hands, I do swear that I have always believed, that I now believe, and that with the help of God, I shall always believe everything that the Holy, Apostolic and Roman Church maintains, recognizes and teaches.”

Then he recalled the text of the sentence and continued thus:

"In consequence, seeking to banish, from the thoughts of your eminences and of all Catholics, this vehement suspicion rightly conceived against me, I hereby, with sincere heart and unreserved faith, do curse and detest the said errors and heresies, and I do swear that in future I shall neither say nor affirm by word or writing anything which may cause such a suspicion to be held against me. Further, I pledge myself by oath to fulfil and faithfully to observe all the penances which have been imposed upon me by this Holy Office.

"If it ever happen—may God preserve me from it—that, through any word of mine, I infringe these promises, protestations and oaths, I submit myself to all the pains and tortures which have been decreed and promulgated against such crimes by the sacred canons and other constitutions: and so help me God, and the Holy Gospels which I touch with my hands."

History tells that, rising, he murmured under his breath: "*E pur si move*" — "Yet it does move."

He was then led back to the Holy Office until the evening of the twenty-fourth, then confined in the Villa della Trinità del Monte. Six months later, through special dispensation, the Pope permitted him to return, not to Florence, but to his villa at Arcetri. He lived on for four years, a blind man, and died at the age of seventy-four.

Returning to our own times, I am reminded of the greatest benefactor of humanity, the man to whom we owe the most precious possession upon earth, our health. Nothing can equal the glory of Pasteur, nothing can equal the gratitude humanity feels for him, and nothing, too, can equal the hatred directed towards him by the physicians of his day.

This chemist-genius discovered the cause of our illnesses, totally unknown to physicians; he unmasked our most fearsome enemies, microbes, and armed us against their attacks; and he saw rise against him all the champions of outworn ideas and of hallowed authority. Thrice he was rejected by the Academy of Science; when he entered it after his fourth attempt, he was elected by a majority of four votes. At the Academy of Medicine, it was by a majority of one vote!

During Pasteur's last years, when I was a student at the medical school in Paris, students were mercilessly failed if they were rash enough to quote Pasteur's discovery. Death alone put an end to this rancor, or to be more accurate, this rancor was stilled only upon the death of those recalcitrant old men. They could not forgive him for having surpassed them, for giving them lessons in medicine, when he himself was not even a doctor! Jealousy blinded them so utterly that they denied even the plainest facts, those which Pasteur proved most clearly.

He had to struggle in order to demonstrate the absurdity of the theory of spontaneous generation of living be-

ings; to struggle in order to convince physicians that microbes cause our illnesses; to struggle in order to force them to fight these illnesses with vaccines which he had recommended; to struggle in order to teach surgeons the necessity of washing their hands and sterilizing their instruments so as to cease killing patients they operated on by introducing infection into the wound themselves; to struggle in order to cure men bitten by mad dogs; to struggle again and again, to struggle for ever.

Men belonging to the same social class are always the most formidable enemies that rise in the path of genius. This fact, of course, holds good in every profession; but I must add that I am afraid the tendency is carried somewhat too far in the medical world.

To describe all the struggles which Pasteur was forced to wage against routine, stupidity, jealousy and envy would require a whole volume. I shall limit myself to reporting some of the most striking episodes.

Pasteur left his patience—that great patience, the prime essence of his genius—behind him in the laboratory. When, at his usual slow gait, he entered the old chapel of the Charité Hospital—where the Academy of Medicine had been meeting every Tuesday since 1850—he was more like a bull entering the arena than a martyr professing a new faith. Impetuously, he would charge upon his opponent, sparing no violence of thought or language when it came to stigmatizing ignorance or bad faith. Some of his sallies have become a part of legend.

One day, for instance, M. Poggiale, former chief pharmacist of the Val de Grâce Hospital, attempted to revive the theory of spontaneous generation.

"M. Pasteur has told us," he said, "that for twenty years he has been searching for spontaneous generation without ever discovering it; he will continue to search for it a long time, and, in spite of his courage, perseverance and wisdom, I doubt whether he ever finds it. The question is practically unfathomable. Nevertheless, those who, like myself, hold no fixed opinion on spontaneous generation, still have the right to verify, to examine, to discuss the facts, as they arise, from whatever source."

"What!" retorted Pasteur. "I am to devote twenty years of my life to a subject, and then to have no opinion? The right to verify, to examine and discuss is to belong only to a man who never lifts a finger to enlighten himself, to a man who reads our works more or less attentively, with his feet on the andirons of his fireplace?"

"You have no opinion upon spontaneous generation, my dear colleague; I can well believe that, though I deplore it. Naturally, I forbear from speaking of those sentimental opinions which every one entertains, to a greater or lesser degree, on questions of this nature. After all, within these walls dedicated to research and progress, we do not indulge in sentiment or theories for the mere pleasure of the thing. You say that, given the present state of science, it is wiser to form no opinion. Well, *I* have an opinion, based not on feeling but on reason, because I

have acquired the right to it through twenty years of assiduous labor. May I add that any impartial spirit would do well to share it.

"My opinion, or, better still, my conviction is that, given the present state of science, as you rightly say, spontaneous generation is a chimera. Further, it would be impossible for you to contradict me, since my experiments are valid, and each stands its ground, a living proof of my contention.

"In short, what are you driving at—you, the declared partisans of spontaneous generation, or you, its complacent or unconscious supporters? Do you wish to assail my experiments? Very well, attack my experiments. Prove them inaccurate, instead of forever offering fresh ones which are but variants of my own, and which introduce errors that must be pointed out to you later."

Vanquished on this point, the opponent summoned metaphysical aspects of spontaneous generation to his aid. Pasteur leaped upon him:

"Science," he declared, "must never in any way consider the philosophical consequences of its labors. If, having developed my experimental studies, I could finally manage to demonstrate that matter may spontaneously organize itself into a cell or a living being, then I would come to proclaim it, here, within these very walls. And I would do so with the legitimate pride of an inventor, fully aware that he has made a major discovery. What is more if driven to it, I would add: 'So much the worse for those

whose doctrines or theories do not agree with the truth of natural facts.' Now, at this moment, it is with exactly the same pride that I defy my opponents to contradict me and I maintain that, given the present state of science, the doctrine of spontaneous generation is a chimera. And, with no less independence, I add: 'So much the worse for those whose philosophical or political ideas are put out of joint by my studies.' "

Then, with one of those sudden changes habitual in the man, Pasteur, softening his tone, continued:

"Does that mean that, in my inner consciousness and in the conduct of my life, I am governed solely by the findings of science? Even if I wished to, I could not do so, for I would have to divest myself of a very real part of myself.

"In all of us there are two men: the scientist who, having made *tabula rasa*, seeks by observation, experiment and reasoning to rise to the knowledge of nature; and the sentient man, the man of tradition, faith or doubts, the man of sentiment, who weeps over his departed children, who, alas, cannot prove that he will see them again, but who believes and hopes so, who does not wish to die like a vibriion, who tells himself that the force within him will be transformed. The two domains are distinct; woe to him who would have them encroach on each other, in the imperfect state of human knowledge!"

Such outbursts shocked the venerable old men who constituted the Academy. As a rule, their discussions were

so much harmless chit-chat. While a loquacious orator held forth from the rostrum, the academicians exchanged gossip about their little personal affairs. Just as today, the sessions of the Academy were more like an inattentive class than a congress of scientists. They would meet every Tuesday, to pass the time of day, to weave the webs of future elections, to belittle this man, to carp at that, and, in a word, to relax. Then Pasteur would suddenly appear to upset the pattern! His vibrant voice rose above the hum of private conversations; gossip could no longer hear his fellow-gossip's tattle; their dearest habits were shattered, rudely and so violent withal. Why, this sort of speech carried the spirit of discussion to actual insult.

One day, exasperated by two particularly obtuse opponents, Pasteur went so far as to tell them:

"Do you know what you two lack? You, the art of observation; and you, that of reasoning."

No one uttered a word; a shocked and reproving silence hovered over the assembly.

"I am sorry for my quick temper," said Pasteur. "The heat of the discussion swept me off my feet. I beg my colleagues to accept my apologies."

A fresh silence ensued, this time a silence of approval. Whereupon Pasteur added: "I acknowledge my error cheerfully. But I can still plead extenuating circumstances. All I said was true!" Another silence. "Absolutely true."

Such ingenuousness disarmed the assembly, which for once did not insist on calling him to order.

Towards the end, any man but Pasteur would have been content to retire, as he surveyed his position. Was he not laden with honors and dignities, overwhelmed with fame and glory? Had he not triumphed over a number of the most dread scourges known to humanity? Was not the fruitfulness of his work assured, and did not that band of worthy disciples at his side bear living proof of it?

But Pasteur, at sixty, thought otherwise. Intrepidly, this sexagenarian did not hesitate to embark upon one final venture, on which, as usual, he staked his all. A venture far graver, indeed, than any he had ever undertaken, since people were destined one day to go so far as to call him murderer. But Pasteur never shied at an obstacle, nor bridled at a hazard.

The enigma that haunted him was rabies; it harried and harassed him, and he must free himself of its molestation. To be sure, the six-year struggle that lay before him was to sap the best of his declining years; but no matter, when at last he agreed to rest, rabies had virtually disappeared from the face of the earth.

Our knowledge of hydrophobia, before Pasteur, may be set down in a few lines. Since ancient times, man had known that the disease is transmitted by the dog. Not all those who were bitten were doomed to certain death, for the method of immediate cauterization, recommended by Le Roux in the seventeenth century, was still in use, and

saved a small number. But once the dread symptoms appeared, death was inevitable. And it was still customary, in remote country districts, to put sufferers out of their misery by stifling them between two pairs of mattresses.

Pasteur discovered the treatment for rabies, and confirmed its efficacy by experiments on infected animals. It remained to apply it to human beings. The long road Pasteur had followed so confidently for forty years now led him, at long last, to an impasse. Here, a lone man, standing at the foot of a high, massive wall, he hesitated for the first time in his life. Doubt assailed him; he was appalled by his responsibilities. Would he dare take the last hurdle?

At intervals, Pasteur had been communicating the progress of his research, in reports he presented to the Academies; physicians, everywhere, followed the proceedings with passionate interest. On July 6, 1865, three peasants—a man, Théodore Vone; a woman, Madame Meister; and a child, her son Joseph—came to his laboratory, armed with a letter from Dr. Weber, of Villé, in Alsace. The practitioner explained that the man had been bitten by his dog two days before; the child, Joseph Meister, aged nine, had been attacked by the same dog on the same day, suffering deep bites on hands, legs and thighs. The autopsy on the dog gave every indication of rabies.

Théodore Vone had been protected by his clothing; he was in no danger, so Pasteur promptly sent him home. But

little Meister's wounds were deep and numerous; he seemed doomed to certain death, as Drs. Vulpier and de Grancher agreed when Pasteur, in his anxiety, consulted them.

After the cruelest inward struggle—which he was later modestly to term “not without lively, bitter anxiety, as may be supposed”—Pasteur decided to try upon Joseph Meister the method which had been consistently successful on dogs.

In the course of a fortnight, the child received thirteen inoculations, the last of them being marrow, calculated beyond a shadow of doubt to infect a dog within ten days. Yet Joseph Meister at no time displayed the slightest symptom of hydrophobia.

While Pasteur was rejoicing over this victory, another child, Jean-Baptiste Jupille, was still under treatment. This youngster was the type of hero dear to Pasteur's heart. To protect six of his playmates, young Jupille had come to grips with a mad dog, knocked him down, tied him up, and then kicked him to death with his wooden shoes. His hands had been badly bitten. Though this had happened six days before he came to the laboratory, the treatment was successful and he recovered.

These two victories won over the majority of country doctors, who thenceforth sent Pasteur any patient suspected of rabies. By February 1886, 305 persons had already been treated.

On December 9, 1885, Pasteur suffered one of the

greatest sorrows of his life. A month earlier, a child of ten, Louise Pelletier, had been brought to him; she had been severely bitten in the head, fully thirty-seven days before. Reason cautioned him to refrain from acting; his opponents, still up in arms, would pounce on the opportunity of damning his theory if a single child were to die after treatment. The outcome seemed hopeless. But Pasteur often obeyed the dictates of his heart rather than those of his own interests, even scientific ones. He undertook the treatment.

Though rabies had seemed imminent, Louise Pelletier showed no symptoms during the entire period of the injections. She even went back to school, and, since she lived in Paris, Pasteur kept a watchful eye on her. By the end of November, undoubted signs of rabies appeared. Inoculations were once more administered, but in vain. Her agony, each phase of which Pasteur attended, was horrible. At last she died, her hand wet with the tears of her great friend, who would have given his life to save her.

As Pasteur had foreseen, his opponents seized upon Louise's death, exploiting the circumstance with a malice amounting to hatred. For weeks at a time, certain victims who had come to Paris for inoculation, hesitated. The political press, the café singers and the caricaturists, all joined in the fray.

In March 1886, nineteen Russians from Smolensk were sent to Paris. All bore terrible wounds inflicted two weeks

previously by a mad wolf. The five most serious cases were lodged in the Hôtel-Dieu Hospital. The others visited the laboratory twice a day, since, in view of the gravity of the case, Pasteur had decided to inoculate them morning and evening. Three of those in the hospital died, the sixteen others recovered, a magnificent achievement, since Russian statistics on bites by mad wolves showed a mortality rate of 82%.

By November 1, 1886, seventeen hundred twenty-six persons had received anti-rabies injections, of whom only twelve died. Based on the most optimistic statistics, the death rate had been 16% before Pasteur's discovery. Thus, of the seventeen hundred twenty-six patients Pasteur had treated, two hundred sixty-four should have succumbed.

Even such facts and figures did not prevent the opposition from proclaiming far and wide that Pasteur's methods were harmful. Each case was argued from the standpoint of non-mortality in rabies. As for those who died despite the treatment, the awful charge of homicide by negligence was actually brought forward.

Remembering how Pasteur reacted to purely scientific opposition, we can imagine his state of mind when the life or death of hundreds of innocent people was at stake. Here was no longer a method, or a theory he must defend; it was a question of saving the lives of patients whom these defamatory campaigns threatened to keep away.

His reply to this campaign of wilful ignorance, obsti-

nacy and malice was characteristic; it took the form of a series of new experiments. Accused of having presented mankind with a new species of rabies, a sort of monstrous creation of the laboratory—rabbit rabies, as it were—he added further and greater proof of the correctness of his treatment of rabies. In vain; the many cares and trials he had suffered overwhelmed him and prevented him from continuing. The fearless, ardent, aggressive fighter was weakening. He was persuaded to go to Bordighera to regain his strength. It was high time—his great heart already showed grave signs of weakening.

Pasteur had cause to rejoice, however, at the spirited champions who remained in Paris to plead his cause. Vulpian, his fellow-worker and witness of the first inoculations, was foremost among them.

“Have done with this inexcusable war!” he told the malicious detractors of anti-rabies vaccination. “You are assailing one of the greatest discoveries ever made. The long series of studies which has led M. Pasteur to this discovery is admirable in every respect. . . . M. Pasteur’s glory is such that it will wear out the fury of his fiercest opponents. When our names and our works have been buried these many years by the rising tide of oblivion, his name and his works will still be shining brightly, from heights too lofty ever to be reached by that sad tide!”

On April 12, 1886, a commission officially delegated by the British government, with Sir James Paget as president, arrived to investigate the results of anti-rabies vaccina-

tion. Its conclusions, after fourteen months of labor and minute examination, were unreservedly laudatory: "It would be difficult to exaggerate the usefulness of this discovery, both in a practical sense and in its application to general pathology."

Thus, the last faint rumors of opposition were drowned out in a tumult of enthusiasm. On his return to Paris, Pasteur was at last to witness the fulfilment of his life's great dream. An international subscription was launched to found an institute of vaccination and research, to be called the Pasteur Institute. It opened its doors on November 14, 1888. And so, Pasteur became immortal while still alive!

CHAPTER XIX

THE STRUGGLES OF PHILOSOPHERS

Philosophers are not fighters, they are peaceful beings who consider intellectual speculation to be the greatest source of happiness in this world. They stand aloof from the active life and apart from our futile agitation. Yet several of them were obliged to put up a hard struggle to defend their ideas, and several suffered most cruelly.

The fact is that the subject-matter of philosophy is extremely diverse, ranging from metaphysical concepts, which wander off into the clouds, to ideas on morality, religion, ideals, politics, all of which are very close to us.

Metaphysicians have always been left to go their ways in peace. They are concerned with subjects of which they have no knowledge, subjects like the ultimate reality of everything, of life, of creation, of the world's destiny, and so forth. In this vast sphere of the unknown and the inaccessible, they swing on their cerebral flying-trapezes to show us how, by dint of putting their thinking cells through intense gymnastics, they have trained them to climb to dizzy heights whence nothing is visible. Moreover, they smother their vague dissertations in a language that is even vaguer and more obscure. The reader can grasp nothing because there is nothing to grasp; nor is

there any reason for anybody to trouble the innocent, useless divagations of these jugglers of hollow phrases.

As for those philosophers who study the rules of logic, in order to teach us the ideal way of thinking, they are accomplishing a worthy task; no one has ever dreamed of showing them the slightest animosity. Similarly, no one has persecuted philosophers who discourse on aesthetics or the ideal form of beauty.

Very different, however, is that philosophy which teaches the lofty principles of morality, of wisdom, of the ideal conduct and best government here below. Virtue was never too highly prized by men; consequently, philosophers, like Confucius and Socrates, who sought to propagate it by their own example, their word and their writings, reaped a harvest of ingratitude and molestation.

Fate was no kinder to the philosophers who descended from the summits of purely speculative thought and undertook to convince mankind that they had conceived an ideal organization of society, infinitely superior to that which governs it. Of this school, Plato's utopia offers the best example, with its luminous critique of political régimes and its absurd social concepts, cheek by jowl. Was not Cicero right in saying: "There is nothing so absurd that you cannot find it in the works of philosophers."

Finally, there are the philosophers who were excommunicated and hounded for their religious ideas and their substitution of philosophical conceptions for sacred dogmas.

Thus, side by side with an innocent philosophy occupied with abstract subjects, there is a revolutionary philosophy, which seeks to fight the vices of mankind, to teach wisdom and virtue, to inculcate a purer conception of religion, to frame an ideal political state. Those who championed such ideas were put to much suffering. Their number is legion; I shall limit myself to four, beginning with the great Chinese philosopher, *Confucius*.

He was born into a troubled age in the year 551 B. C. The princes were then more powerful than their nominal sovereign; they encroached upon one another's domains and made war at the instigation of ministers more crafty and more ambitious than themselves. The people, crushed under the iron heel of the tax collector, were torn away from their fields, and driven to whatever work suited their sovereign's whims. Several incidents in the sage's life prove that this picture is not exaggerated. One anecdote, for instance, tells how he happened to be passing by Mount T'Ai, and heard a woman lamenting. He despatched a disciple to inquire why she should be filling this deserted place with her lamentations. Returning, the disciple gave her reply: "My husband's father was killed by a tiger, and my husband, and my son also!" "Well then," Confucius asked, "why does she stay here, in this desolate place?" "Because," came the woman's reply, "here there is no one to oppress me." "My friends," said the master to his followers, "remember this. A tyrant's rule is even crueller than a ravenous tiger."

This philosopher taught five cardinal virtues: kindness, justice, decency, wisdom and sincerity. In a corrupted generation, where vice stalked in broad daylight and virtue hid her head in shame and despair, his life remained spotlessly pure.

Yet he dealt with practical ideas. In government, for instance, he affirmed that the prince should be a model of all virtues to his people. It was part and parcel of his theory that the influence of virtue should descend from majesty to populace, from the high places of the court into the lowest walks of social life. Accordingly, he obtained a post attached to the prince of the State of Lu, hoping to train him in the ways of lofty virtue; unhappily, the prince proved wholly impervious to such teachings. The Sage's position became untenable when Prince Lu accepted a gift of eighty singing girls. Confucius realized how unequal any struggle between virtue and vice must be in his native land, and therefore resigned.

He was forced to flee, to seek elsewhere a more propitious ground for cultivating virtue in man. To be sure, failure dogged him throughout his years of wandering; but his philosophy was destined to endure. Indeed, after his death in 478 B. C., his teachings spread throughout China.

In the magnificent temple consecrated to him at Peking, there is neither statue nor image. But the spirit of the great sage of China reigns there in all its purity, and, on

my last visit, I was deeply impressed with its calm and its serenity. . . .

About a century after Confucius, *Socrates*, too, taught wisdom and virtue, and, again like Confucius, in a period of trouble and confusion.

Athens was then in a state of anarchy. The general assembly constituted the supreme power; the highest official body consisted of more than one thousand members, selected in alphabetical order from the list of citizens. It was the most democratic, and, some said, the most absurd of institutions. The passionate, tumultuous throng appointed generals as swiftly as it recalled and executed them, deciding upon all matters in haste and ignorance, only later and at leisure, to know repentance and sorrow. Conditions were further complicated by the struggle between this tempestuous mob and the aristocracy, which sought to assume power.

The philosophy of Socrates, predicating government by the most worthy, the wisest and the most intelligent, could not fail to rouse the violent hostility of the crowd, omnipotent in its rule. The death sentence by hemlock was inevitable. His friends came to visit him in prison; having bribed the guards, they offered him a way of escape. Socrates refused.

"Be of good cheer," he told them. "Remember that it is but my body ye shall bury."

Plato's account of the master's last moments is one of the most moving pages in the history of man; Socrates died, as he had lived, a sage.

"Having thus heartened his friends, he rose and passed into an adjoining room in order to bathe. Criton followed him; Socrates begged us to wait. We therefore waited, now discussing and meditating upon his latest words, now pondering the great misfortune about to fall upon us. We knew full well that with the loss of a man we considered our father, we should have to spend the rest of our days as orphans. . . . It was now almost sunset, for Socrates had tarried long in the room. Returning from his bath, he sat down beside us; little time remained for any but a brief conversation. Almost at once, the sergeant of the eleven entered, and, advancing towards him:

" 'Socrates,' he said, 'I shall not blame you, as I do others, for the anger and hatred they bear me, and for the curses they heap upon my head, when, by order of the magistrates, I warn them that the poison must be quaffed. You—whom I have known, especially in this instance, to be most generous, the kindest, and the best of those who ever came here—you will not, I am certain, rage against me, even in this moment, but rather against those who are truly guilty, and well you know them. Now, therefore, you are aware of what I have come to tell you. Farewell, then, and try to resign yourself to the inevitable.' Then he burst into tears, turned about and withdrew.

"Socrates glanced up. 'Farewell to you also!' he replied. 'What you say shall be done.' Then, to us: 'What a gracious man he is! Throughout my stay here, he would come to see me. Sometimes we would hold converse. He was the best of men, and now, see how he weeps! Ah, well, Criton, let us obey him. Let the poison be brought, if it is already ground; otherwise, let the jailer grind it.'

"'But Socrates,' Criton protested, 'the sun still rides high over the hills. . . . Besides, I know that others do not drink it until long after the order has been given. They eat heartily, drink deeply, and some have commerce with those whom they desire with love. Do not hasten; you, too, have time for these things.'

"But Socrates answered: 'Not without reason, Criton, do those you speak of behave in this wise. They believe they have something to gain thereby. But I, too, have my reasons for behaving as I do. For I believe I have naught to gain by drinking the poison a little later, save only to expose myself to my own scorn, in that I would be clinging to life, and sparing that within me which no longer exists. Go, then, and do my bidding, and not otherwise.'

"At these words, Criton signalled to the slave who stood quite near; the slave went out, and, not long after, returned with him who was to administer the poison. He bore it, ground, in a bowl. Seeing the jailer, Socrates said: 'My friend, since you are used to such things, tell me what I am to do.'

“‘When you have drunk, you need but walk about the room, until you feel your legs grow numb. Then lie down, and the poison will act of itself.’

“As he spoke, he handed the cup to Socrates, who took it with perfect grace. Betraying never a tremor, without change of color or expression, Socrates pierced the bovine stare of the man and caught his glance.

“‘What of this cup as a libation to the immortal gods?’ he asked. ‘Is it permissible or not?’

“‘No, Socrates, we grind only what we believe to be the measure of the brew.’

“‘I see,’ said Socrates. ‘Still, I think we can, and must, at least pray the gods for a fortunate passage from this world to the next. So be it for me; that is the burden of my prayer!’

“So saying, he bore the cup to his lips, and drank the poison down blithely and with good cheer.

“Until then, most of us had been able, for a while, to contain our tears; but when we saw him drain the cup to the dregs, we could control ourselves no longer. For all I could do, for all that he was beside me, the tears coursed down my cheeks, so much so that I covered my face and wept upon my own breast. For it was not him I mourned, but myself and my misfortune, thinking of the friend I was about to lose. Some moments before, unable to check his tears, Criton had risen and left the room. Just then, Apollodorus, who had been weeping, unashamed, burst into sobs, and all those present, saving

only Socrates, felt their hearts break within their breast. But Socrates comforted us.

“‘What strange cries are these, my friends,’ he said. ‘If I dismissed the women, it was chiefly because I wished to avoid any untoward noise, since I have heard say that death must be accompanied by a religious silence. Be calm and resign yourselves.’

“His words made us blush with shame, and we gave over weeping. Meanwhile, Socrates walked around his cell; then saying that he felt his legs grow numb, he lay on his back, according to the jailer’s prescription. Then he who had given him the poison grasped him, and, a moment later, examined his feet and his legs, pressed his feet firmly, and asked him if he felt anything. Socrates replied that he did not; thereupon, the man pressed his legs, his hands moving gradually upward, and showed us that Socrates was growing colder and stiffening. Then Socrates touched his own flesh and said: ‘When the poison reaches my heart, it will be the end.’

“Already the chill was creeping towards the lower belly. Socrates, partly uncovering his face, over which he had thrown a veil, spoke—and these were his last words: ‘Criton, I owe Aesculapus a rooster; do not fail to pay my debt.’

“‘It shall be done,’ said Criton. ‘But have you naught else to tell me?’

“The question met with no response, but Socrates moved ever so slightly. Then the sergeant lifted the veil

from Socrates' face, and we saw that his eyes were glazed. Criton closed them, and his lips, also.

"Even so, O Echecrates, was our friend's passing; even so was the end of a man we may call the noblest of his time ever we saw tested, and, more, the wisest and most just of humans."

Plato, a disciple of Socrates, met no such tragic end. His efforts to save Socrates had made him suspect to the chiefs of the democracy; his loyal friends convinced him that he was no longer safe in Athens. He left, to return twelve years later.

During the interval, times had changed. Plato was now an honored citizen and could expound his philosophy to his many adoring disciples. Unfortunately, he was rash enough to remove to Syracuse, to enlighten the reigning prince, Dionysius, in the ways of ideal government.

According to Plato, only a philosopher king is capable of leading a people. "So long as philosophers are not kings," he asserted, "and the princes of this world are not truly and completely philosophers, so long as political power and philosophy do not meet on common ground, neither states, nor, I fear, the human species will find an end to their troubles."

When Dionysius heard the noble, utopian ideal of the just state and realized that it meant he must either turn philosopher or abdicate, he solved the problem in true tyrant fashion by selling Plato off as a slave.

THE STRUGGLES OF PHILOSOPHERS

Plato was fortunate enough to be redeemed by his friend and pupil, Annikeris. The lesson taught him to stop attempting to convert ruling princes to his ideal system; and he was allowed to end his life peacefully, propagating his ideas among the students at his Academy.

His disciple, *Aristotle*, proved less fortunate. So long as his most celebrated pupil, Alexander the Great, protected him, Athens could do him no great harm. But when his powerful defender very suddenly died, all Aristotle could plead in his own favor was an innumerable list of works on biology, logic and philosophy. Alas, in times of trouble, amid the struggles of political parties, scientific worth offers the feeblest of safeguards. Aristotle's crime was that he belonged to the Macedonian party, which was overthrown at Alexander's death. Most of the mighty conqueror's partisans took to flight. Aristotle had to follow suit, if he would spare Athens the shame of committing a second crime against philosophy. Diogenes Laertius tells us that, in despair at seeing everything crumble, he committed suicide by drinking hemlock.

Again, two thousand years later, a celebrated philosopher had to struggle and suffer for his ideas. *Spinoza* was excommunicated on July 7, 1653. Van Vloten has published the formula of excommunication, from which I quote:

"The chiefs of the Ecclesiastical Council make known

by these presents, that, already informed of the acts and guilty opinions of Baruch Spinoza, they strove, in divers manners and by promises, to divert him from his evil ways. But, being powerless to restore him to resipiscence, and, rather, fortified daily in their certitude that he upholds and acknowledges terrible heresies cynically propagated and spread abroad, as many persons worthy of credence have asserted in the presence of the said Spinoza, the latter was judged to be guilty. The matter having therefore been examined in assembly by the heads of the Ecclesiastical Council, it was decided unanimously to utter the sentence of excommunication against the said Spinoza and to cut him off from the people of Israel."

What caused this excommunication was Spinoza's contention that the Bible contains a swarm of errors, contradictions and absurdities; that the miracles were invented in order to thrill and to seduce the imagination of the vulgar man; that God and nature were one and the same; that the will of God and the laws of nature were a single reality.

History has recorded the wretched but stoic life of Spinoza after his excommunication. He divided his time between the manual labor necessary to assure his meagre livelihood and his philosophical writings.

On the occasion of the two hundredth anniversary of his death, a subscription was undertaken for the purpose of erecting a memorial statue at the Hague. Contributions poured in from all points of the civilized world.

At the ceremony of inauguration, in 1877, one of the greatest French philosophers, *Ernest Renan*, concluded his address with the following words:

“Woe to him who, passing, should insult this mild and thoughtful face. He would be punished, as all vulgar hearts are punished, by his own vulgarity and by his inability to grasp the divine. That great philosopher, from his pedestal of granite, will teach one and all the way to that happiness which he himself discovered; and in centuries to come, the cultivated man passing down the Pavillonengrat, will say to himself: ‘Here, perhaps, God was most clearly seen’.”

CHAPTER XX

FROM GENIUS TO CRETIN

In this, the concluding chapter, I should like to explain the origin of this book.

I have had the good fortune to be thrown together with some men of genius, a small number, since geniuses abound at no period, and in ours, where mechanics predominate, they are particularly scarce. People know of the affectionate friendship that binds me to *Maeterlinck*, one of the greatest geniuses of our time—a poet, dramatist, philosopher, an universal spirit, who explores the visible, and rubs shoulders with the infinite; who scrutinizes matter, and, in that indefinite division where it borders on the immaterial, seeks to divine the enigma of creation.

I have known *Gabriel d'Annunzio*, whose burning word, whose sparkling mind, and whose dynamic imagination attested the passionate soul of a poet of antiquity.

I cherish my association with the great French scientist, *Edouard Branly*, whose thought reached far beyond our own age—Branly, the creator of voice transmission across space, which Marconi made practical; the inventor of the radio conductor which bears his name, without which wireless would be impossible. His luminous spirit paved

the way for further and mightier discoveries which humanity will see applied only in centuries to come. To him I owe a vote—the only vote I ever received—for membership in the Academy of Medicine. They were voting for some candidates whose names I have forgotten. I myself, of course, was not included among them, since I have never offered my candidacy, aware beforehand of the fate it would meet. One ballot, however, bore my name, a fact that excited general hilarity, which ceased abruptly when the academicians learned who had cast it.

My relations with *Saint-Saëns*, composer of *Samson and Delilah*, and an accomplished pianist, also afforded me some hours of exquisite music.

Greater still was the number of men I knew in France, Italy and America, who were endowed with a genuine talent. I mention only the dead, lest I commit an injustice by omitting some worthy few from among the living ones I have met. I shall cite the great sociologist, Gustave Le Bon—or was he not, perhaps, a genius? Edmond de Goncourt, Rosny the Elder, and Francis de Croisset, among writers; Professors Edmond Retterer in Paris, Camille Golgi in Italy and Harvey Cushing in the United States, eminent physicians and surgeons.

Many men of talent whom I have known still live and continue to enrich the patrimony of thought in literature and in science. To this list must be added a few greatly gifted painters and sculptors, with whom I also spent some time.

But those I have known in even greater numbers were cretins. I do not refer to the sorry-minded variety with whom we are thrown into daily contact; I mean real cretins, beings deprived of intelligence from birth by the atrophy of their thyroid gland. They have taught me a great deal. More than geniuses, they have revealed to me the secret of the awakening and development of thought, in its first faint glimmerings and in the successive stages of progress by which it eventually blossoms forth into human intelligence.

It was in June 1913, that I presented before the French Academy of Medicine the first cretin whose intelligence I had restored by grafting a chimpanzee's thyroid gland on him. On October 5, 1937, I communicated to the Society of Comparative Pathology in Paris my observations of several men and women, between the ages of twenty-eight and thirty-nine. They had been cretins, but now, having undergone thyroid grafting twenty years before, had become quite normal human beings. I did not make geniuses of them, but I reinvested them with sufficient intelligence to enable them to behave normally in life, instead of continuing to be a burden, either to their families or to the state, in asylums for the feeble-minded.

The fact that their brains had recovered their mental functioning power proves that they had indeed been born with well-constituted brains, but that they lacked something necessary to the manifestation of intelligence. That something I restored to them by furnishing them with the

liquid secreted by the thyroid gland. Under the influence of this addition, the brain emerged from a sort of torpor, and reassumed its psychical functioning. But what action can be attributed to this liquid, which, by its presence, sets thought in motion? An organic liquid penetrating into a living cell can only form chemical combinations with other elements to be found in it. Thought, therefore, appears to be the result of a chemical reaction, in which the secretion of the thyroid plays the determinant part.

I have had occasion to corroborate this through observation of reverse cases. My grafts were not *always* successful. In contrast to the fortunate cases, which have thrived over a period of twenty years, I have had several others in which, through fortuitous circumstances, the graft has been reabsorbed within two or three years. It was a heart-rending spectacle! A child that had already given proof of a fine recovery of intelligence, fell back into idiocy.

Our intelligence, our consciousness, our will and our feelings are indeed due to certain chemical reactions inside the brain cells, a fact I could not fail to appreciate. In my laboratory at the Collège de France, I retained a cretin upon whom I grafted at the age of nineteen. He was one of my guinea-pigs; but insofar as he himself was concerned, it was a psychical experience. Day by day I witnessed the awakening of his intelligence. His raucous cries became subdued, human language began gradually to shape itself. He emerged from a sort of lethargy. His

first questions were recorded; they were those an infant of four or five usually asks. The idiot stare began more closely to resemble an intelligent glance; curiosity was coming into play; at last he laughed. The man was born in him. I witnessed the birth and the evolution of psychical functioning in cerebral matter, transformed from inert into thinking matter, as a result of the thyroid liquid.

To turn again to geniuses, I have no hesitation in stating that I can make cretins of them. I would meet no failure in such an undertaking; I could assuredly make a cretin out of every genius merely by removing his thyroid gland. I have not made the test, but nature has. Indeed, we find children who are perfectly intelligent at birth, and even naturally gifted; suddenly, some illness, frequently measles, may strike them at the age of eight or ten, and occasionally that is followed by atrophy of the thyroid gland. Invariably within a few months, these children become idiots.

By implication, these facts all lead to the same conclusion. Cerebral matter cannot become thinking matter, save through a determined chemical reaction. What will be the product, what character are we to attribute to the mind? I have answered the question in Chapters I and II of this book.

Atrophy of the thyroid gland is sometimes not complete; a small portion survives. It is insufficient to stir mental activity in the entire mass of the brain, but it may suffice to stimulate one small, isolated centre, composed

of highly evolved cells, endowed with superior qualities. Hence the occasional manifestations of a genius-like aptitude in the brain of a cretin.

I shall not dwell further on the part played by the thyroid gland in the manifestations of our psychical faculties. I wish, in this place, merely to indicate the path my thought followed, as a result of my laboratory experiments on the living matter of the brain.

It remained to search for the seat of the quality of genius. Along these lines, geniuses themselves have undertaken to instruct me. Their conversation, while it often betrayed a fine intelligence, nevertheless was not superior to that of people one meets who are wholly innocent of genius. Geniuses reason like everyone else. There is nothing to indicate that these men might, a few hours later, set upon paper some sublime thought, some unique verse or supreme passage dazzling in its beauty. Obviously, there is a splitting of the personality in every genius. Accordingly, two states so different, each independent of the other, cannot have the same seat in the brain; the same brain cells cannot possibly produce both the known and the unknown, both conscious reasoning and unconscious inspiration.

A single observation solved the riddle for me. Among those upon whom I have grafted, there have been some men of vast talent; history may, perhaps, attribute genius to one or two of them. Extremely nervous of temperament, most of them insisted upon general anaesthesia, though

the latter is quite unnecessary in operations of this sort. Generally speaking, nothing noteworthy occurred. Two of them, however, after a complete loss of consciousness, uttered words which impressed me deeply.

One especially, an eminent *savant*, some seconds after complete loss of sensibility and movement, emitted a thought which seemed to me so extraordinary that I considered myself in duty bound to report it to him a few days later. He was struck by it himself, and confessed that he was actually doing research in that field, but had never thought of the solution which he formulated during his anaesthetized sleep.

Similar observations of patients under a general anaesthetic have convinced me that the conscious falls asleep first, and the subconscious a few seconds later. Anatomic considerations which I have described in the chapter on the subconscious enabled me to chart two zones in the brain, the first a superficial zone assigned to the conscious ego, the other, deep-seated, to the subconscious. We have two super-imposed brains: one for daily use, to guide us through life, to shape our thoughts and ideas; the other for exceptional, sporadic, autonomous work performed independently of our consciousness. This latter brain is not an exclusive appanage of genius; every one of us possesses it. Intuitions and presentiments which remain inexplicable, which our conscious ego and our reason often disapprove and repel, belong to this second brain. It is only in its quality, its creative power, that the subcon-

scious of genius differs from that of the average man. I believe I have sufficiently developed what part the subconscious plays in works of literary, scientific and artistic genius, to allow me merely to mention it here, in passing.

It was also of interest to ascertain the source of the genius-like gift displayed by certain men very early in life. I did not consider it logical that a vulgar soul should give birth to a genius. That fact, I thought, held an enigma that eluded us. If the child inherits the mind of father and mother as he inherits their physical qualities, it was difficult to understand how two mediocre intelligences could bequeath the spirit of genius to their child. There remained the possibility that the intellectual heritage may jump several generations; but the family study of certain geniuses over a period of two centuries—the study of Descartes' family for instance—fails to reveal any superior personality. It then occurred to me that perhaps the father and mother, both common and both vulgar, simply played the role of the asses, which in La Fontaine's fable, bear precious relics. Asses are stupid beasts, but the very precious relics these particular asses of mine bore might have belonged to some famous saint who lived many ages before. Searching for the origin of these marvelous relics which, borne by these human asses to a child, make him a genius, I believe I have discovered it in the minute filaments called chromosomes, which are curled up in the germinal cells, where they retain all ancestral

heredity. They never disappear; they are transmitted indefinitely throughout the ages. I have therefore advanced a theory which might solve the riddle of a genius born to the bed of an illiterate peasant and a country wench, each the obscure inheritor of an unknown treasure, deep-hidden in his germinal cells. I have set forth this theory in the chapter devoted to the origin of genius.

In this book, I have attempted to answer certain questions which deal with the mind. I have identified mind with the radiations of the brain, with the projection of infinitesimal grains of thinking matter. In doing so, I have robbed mind of the mysterious province which must remain, if it is to be considered an immaterial entity, impossible of generation *solely* by matter.

I do not believe that, in so doing, I have relegated man to a lower position in the hierarchy of nature. On the contrary; the fact that, into our constitution, there enters matter, each atom of which is a thought, would seem to elevate and to ennoble us. We are not common clay, we are spirit incorporated in matter.

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